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A New Platform for Knee Surgery Patient Rehabilitation, Motivating Mirror: Providing an Interactive Experience to Knee Surgery Patients to Assist Them With a More Effective Rehabilitation.

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A New Platform for Knee Surgery Patient Rehabilitation, Motivating Mirror

Providing an interactive experience to knee surgery patients to assist them with a more effective rehabilitation.

By: Yu He

A Thesis submitted in partial fulfillment of the requirements for the degree of:

Master of Fine Arts in Visual Communication Design

School of Design

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TABLE OF CONTENTS

TABLE OF CONTENTS

ABSTRACT

There are many tools for knee injury patients to use for rehabilitation. Both Physical Therapists and Occupational Therapists work with patients on rehabilitation to help them recover, bring them back from illness or injury. For knee surgery patients, they will go through rehabilitation including CPM (Continuous passive movement) and exercises assigned by PT (Physical Therapists) to improve recovery.

CPM is a passive motion that a machine forces patients to do, and along with and after that, patients need to be active to do other exercises themselves. Lots of patients run into trouble when rehabbing. Some of them refuse to do the exercises because they have a negative attitude about this rehabilitation. Some of them think it's troublesome to go to the gym do the rehab exercises; they just stay at home and wait until their leg recovers. Others are afraid of the rehabilitation. Whatever the reason, it turns out they won't recover very well.

As part of this preliminary study, a survey was presented to patients who had knee injury and doctors who are expert in knee surgery. The patients were asked if they would find it beneficial and appealing to have a more effective experience while they taking rehab exercises. The general consensus was they would find useful as they could be more interested in rehab instead of forcing themselves go to a hospital. On the other side, doctors weren't so sure about it because we don't have anything similar on the market. Besides, this project wasn't so fascinating since the rehab exercises are limited and repeat.

This project is trying to help patients Help the patient to recover consciously, help them maintain their health level or to have the passion to explore ways to improve it, and help recover patients' both physiological and psychological health.

ABSTRACT

The purpose of this design would be that users could increase flexibility while they have walking limitations, and encourage them with more effective rehabilitation.

Keywords:

Rehabilitation, Medical health, Exercises, Way finding, User Interface Design, Video prototype, Interactive

Project Website:

http://yuheheyu.com/thesis.html

Video Prototype:

https://vimeo.com/218472552

Situation Analysis

Knee surgery patients typically have exercises for rehab. There are many tools for people with a knee injury to use for rehabilitation. Physical Therapists and Occupational Therapists work with patients on rehabilitation to help them recover, bring them back from illness or injury. For knee surgery patients, they will go through rehabilitation including CPM (Continuous passive movement) and exercises assigned by PT (Physical Therapists) to improve recovery.

CPM is a passive motion that a machine forces patients to do, and along with and after that, patients need to be active to do other exercises themselves. Lots of patients run into trouble when rehabbing. Some of them refuse to do the exercises because they have a negative attitude about this rehabilitation. Some of them think it's troublesome to go to the gym do the rehab exercises; they just stay at home and wait until their leg recovers. Others are afraid of the rehabilitation. Whatever the reason, it turns out they won't recover very well.

To make knees recover better, patients needs to have both repetitive and single action. The rehab exercises are long-term, painful, and uninteresting. Based on the questionnaire survey for this project, lots of patients did not go through their rehab perfectly. When this happens, the benefits of rehabilitation are minimal.

Though there might be family members, doctors, and other professionals to encourage and persuade patients, the patients are not well motivated by their own efforts to recover, and the results will not be as good as what they and their families would like.

Situation Analysis

Nowadays there are a series of rehabilitation exercises for people who suffer from knee injury[1]. It usually takes 12 weeks[2] for patients to go back to normal daily life and 16 weeks to regain full muscle strength and increase overall conditioning, but only if they follow the instruction from the PT and do rehabilitation well, and after 12 weeks, it's still important to continue with exercises. While patients go through the rehabilitation, they have to follow the instructions on the equipment in the CPM stage, and have to follow doctors' instructions to do exercises to help with recovery. However, the process that patients go through is rather boring and without passion. In addition, there are lots of patients who are suffering from both physiological and psychological trauma. Patients are unlikely to achieve perfect recovery when they have no power and passion to take part in rehabilitation. Some of them may even be too afraid of pain they need to suffer while exercising to get rehabilitation. As a focus area, people
having knee surgery will be the main component of this thesis project.

To get more information from patients, one on-line questionnaire has been published and has gotten responses from doctors and patients. The main questions include:

- What's the gender of the person injured?
- How old is the patient?
- How badly does this injury affect him/her?
- Did patient go through the whole rehabilitation?
- If yes, what's the process for the rehab? If not, why patient didn't go to rehab?
- What are the commonly used rehab exercises?
- For rehab, will it be different rehab exercises between knee replacement patients and knee surgery patients? And is there any difference between different generations and different occupations?

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1 "Exercises for ACL Rehabilitation." Exercises for ACL Rehabilitation | Sportsinjuryclinic.net, www.sportsinjuryclinic.net/sport-injuries/knee-pain/acl-injury/strengthening-acl-injury.

2 @Hjluks. "Physical Therapy Following an ACL Reconstruction : Expert Series #3 - Howard J. Luks, MD." Howard J. Luks, MD, 28 Oct. 2014, www.howardluksmd.com/orthopedic-social-media/physical-therapy-following-acl-reconstruction-expert-series-3/.

Situation Analysis

- If there is any interactive experience for patients to motivate him/her to do the rehab exercises, what kind of experiences do you think the patients might be interested in?
- If there are some entertainment activities happening while patients are exercising, will these activities diffuse patients' attention and energies, and have bad influences for the rehab? Or will it be helpful for patients to not pay attention to painful exercises?

Based on the responses this questionnaire got, the exercises for rehab are determined by how badly he/she hurts and how long since the surgery for a surgical knee or replaced knee. Most respondents (84.3%) said physical feedback would be a great way to show the patients overall condition, because it can tell them realistically how far along they have come for their recovery. This can give patients a realistic time period of how their progress is doing and roughly how long it will take for their complete rehab of the surgical knee or replaced knee. In addition, 72.9% of participants said digital interaction would be optimal too because at the same time, it will represent the knee of the patient and it can show them how the overall healing process works and what the body is going through to recover knee function. And 78.2% of respondents feel if there are entertainment activities, it will motivate the patients if they can be more interactive with their recovery in rehab. However, it also comes down to price and how much the patient can afford for recovery as opposed to physical feedback with PT covered by insurance or so.

Usually patients get really tired or frustrated about how long the healing process takes. Nevertheless, it is important that patients keep up with their rehab, because it will help them recover following surgeries. If a good distracting tool were provided so that patients would not be so worried about the pain, they could focus on the exercises in a fun and engaging manner. Sometimes we may perceive a lot of pain, but at the same time, we can trick our brain with imagery and distraction to not think too much about the pain.

Situation Analysis

The goal of this thesis project is to provide a solution that people who need rehab for knee surgery may use to willingly take part in rehabilitation and will improve their rehab quality. According to the questionnaire and research, there are different kinds of knee surgeries such as Arthroscopy: Trimming a Torn Meniscus, Meniscus Repair, ACL Reconstruction, Microfracture, etc. For rehab, patients would do a lot of range of motion exercises to get the knee muscles working again and to slowly progress on the movement of the knees to walking around, extension, flexing, and going from a passive range of motion to an active range of motion. This project is focused on adults who are younger than 60 years old because the older generation might need knee replacement which is a different section from knee surgery.

By using AR devices and having an interesting interactive way with patients - such as clearly showing muscle rebuilding, and adding achievements to exercises - patients will be more interested in rehab and improve their recovery. A variety of interactive tools will be used to help develop a comprehensive design for users.

There is a need for a design like this since there is nothing else similar for patients on the market. There are traditional devices for people who had knee surgery that do not use digital interaction. There is AR for doctors to help with surgery, but not for rehab. Most of the patients are not paying attention to get effective rehabilitation. The majority don't take rehab as their first choice because they need to go to a specific place to exercise and the process has no passion, instead they just leave the hurt knee alone.

This product will contribute to fields of both design and health. Through user interaction, user experience, motion graphics, interactivity and augmented reality, patients can have a good experience while rehabbing. Motion graphics will be used to help with fine motor skills and augmented reality will be used for the study of human movement. Since this project is focused on the interface part, motion graphics will also help with the interface design.

Motivating Mirror:

This thesis project explores interaction, user interface, and experience design for patients taking rehabilitation after knee surgery. By using this platform, it is intended that patients will be inspired to take a more active role in their own rehabilitation. The project aims to help them maintain their health level or to have the passion to explore ways to improve it, and recover their physiological and psychological health.

The concept uses an Augmented Reality(AR) design with an interactive display interface, which may be in common use within several years. It is intended to help patients have a better user experience and be more active during their rehab session. Users may interact with the device using visual sensor, voice order, etc.

This project explores interactive designs for the interface to this AR device. Motion graphics provide video prototypes to help viewers better understand this platform.

Although there is a device on the market that can help doctors operate better by seeing through a patients' body and getting detailed information of bones and muscle in real time, there is nothing similar for knee surgery patients. The technology of this project is likely achievable in several years and would be helpful to patients willing to do rehabilitation.

Thesis Statement

Providing an interactive experience to knee surgery patients to assist them with a more effective rehabilitation

SURVEY OF LITERATURE

Books

Don't Make Me Think: A Common Sense Approach to Web Usability, 3rd Edition. Steve Krug. San Francisco, CA, Peach Pit, 2014.

This book discusses web usability and how designers need to be aware of what their audience wants and needs. Krug focuses on how designers need to keep in mind what they are designing and how they are implementing the content, and how to make it the most effective for their audience.

The Design of Everyday Things. Don Norman. New York, New York: Basic Books, 2013.

Don Norman discusses the concept of usability in design. Bad design is prevalent and the need for thoughtful design with the user in mind is a necessity. Norman points out why some designs are successful and how the designs and the design decisions affect their users.

Garrett, Jesse James. The Elements of User Experience: User-centered Design for the Web and beyond. Berkeley, CA: New Riders, 2011.

This book lists author's understanding and summary about elements of the user experience. He have five Plane for user experience: 1) The surface plane 2) The skeleton plane 3) The structure plane define the placement of pages, using process and navigational elements 4) The scope plane 5) The strategy plane. The author's purpose appear to be explain user experience in his own eyes and give us a simplify understanding with user experience. This book is more focus on basic understanding than others and can give us a clearer view about user experience. It's really useful as a guide to introduce user experience.

Helen Sharp. Yvonne Rogers. Jenny Preece. Interaction Design: Beyond Human-Computer Interaction; Second Edition. John Wiley & Sons, 2007.

This book is talking about how to design a product and help people to interactive with it. This is a classic book about interaction design. It has the basic interaction design knowledge we need to use and helpful with our research and design.

Books

Norman, Donald A. Emotional Design: Why We Love (or Hate) Everyday Things. New York: Basic Books, 2004.

In this book the author explains the importance of emotion in design based on three different dimensions: visceral, behavioral level, reflective level. Emotion in many cases has great impact of our decisions. This book gives us a different perspective to learn how to make better interaction design, The author came up with examples and science understanding about exploration.

Rubin, Jeffrey, and Dana Chisnell. Handbook of Usability Testing: How to Plan, Design, and Conduct Effective Tests, 2008.

This is a book that UX people must read. It helps people get an step by step idea about how to test the usability for your product. This book provides an knowledge about what kind of products are users want to have. This book helps designers to consider limit usability and decide when will they need to do user test.

Lotke, Paul A and Jess H. Lonner. Master Techniques in Orthopaedic Surgery Knee. Arthroplasty. Philadelphia:
Lippincott Williams & Wilkins, 2008.

This book described complicated problems encountered in knees surgery, wrote by the authority of the field of reconstruction of the knee. Readers can learn from their own and others' experience to improve their technology. This book focus on technique that experts prefer to use, and want readers to know that mastering knees surgery and managing not only requires a deep understanding of the scientific basis of the surgery, but also the ability to know the clinical decision and surgical subtle discrimination.

Teller, Peter. MRI Atlas of Orthopedics and Traumatology of the Knee. Berlin: Springer, 2003.

This book covers all the important diseases and injuries of the knee joints, for each part of the joint it has a comprehensive description from the normal image

to the disease. Clinical evaluation of imaging is based on detailed diagnosis, disease stage and treatment results from each case data.

Articles & Websites

Goodwin PC, Morrissey MC, Omar RZ, et al. . Effectiveness of supervised physical therapy in the early period after arthroscopic partial meniscectomy, Phys Ther , 2003, vol. 83

This article disscussed will physical therapy helpful for patients after arthroscopic partial meniscectomy. The author did an test with patients who were supervised physical therapy and patients who with a home program to evaluate the effectiveness.

Grant JA, Mohtadi NG. Two- to 4-year follow-up to a comparison of home versus physical therapy-supervised rehabilitation programs after anterior cruciate ligament reconstruction, Am J Sports Med , 2010, vol. 38 https://doi.org/10.1177/0363546509359763

This article is about comparing a home based rehabilitation with a standard physical therapy program. It is a long run analysis about the difference between a patient who did home based rehab and patient who did a clinically supervised rehab.

Berth A, Urbach D, Awiszus F. Improvement of voluntary quadriceps muscle activation after total knee arthroplasty. Arch Phys Med Rehabil.

This article claimed the rehab exercises after knee surgery need to focus on improve voluntary activation. And physical therapy should make sure to increase the muscle strength.

Keays SL, Bullock-Saxton JE, Keays AC, et al. A 6-year follow-up of the effect of graft site on strength, stability, range of motion, functional and joint degeneration after anterior cruciate ligament reconstruction. Am J Sports Med. 2007.

Articles & Websites

This article is a long term study about does the material patients used matter for patients' recover. And for a reliable result, this study keep tracked some case in 6 years.

Linden M, Ejerhed L, Sernert N, et al. Patellar tendon or semitendinosus tendon aurografts for anterior cruciate ligament reconstruction. Am J Sports Med. 2007.

This article is about a study about does semitendinosus tendon graft help patients recover. For a better result, there was a two years case study and finally get a reliable data.

Risberg MA, Holm I, Myklebust G, Engebretsen L. Neuromuscular training versus strength training during first 6 months after anterior cruciate ligament reconstruction. Phys Ther. 2007.

This article wanted to determine the difference of different training for knee surgery patients. And found out there are some certain training are good for patients. This article suggested that patients need more effective training.

Shelbourne KD, Nitz P. Accelerated rehabilitation after anterior cruciate ligament reconstruction. Am J Sports Med. 1990.

This article is trying to find a different way to help patients who had ACL reconstruction. In this test, they asked patients immediate have weight bearing one day after surgery, then they had a long term follow up and get information.

Shelbourne KD, Urch SE. Primary anterior cruciate ligament reconstruction using the contralateral autogenous patellar tendon. Am J Sports Med. 2000.

This article studied the effect of two different autogenous patellar tendon graft for patients' recover speed, and this is a follow up study.

Articles & Websites

Noyes FR, Mooar LA, Barber SD. The assessment of work-related activities and limitations in knee disorders. Am J Sports Med. 1991.
This article performed a prospective randomized clinical trial in which two different occupational rating systems were tested on 50 patients.

Biggs A, Jenkins WL, Urch SE, Shelbourne KD. Rehabilitation for patients following ACL reconstruction: a knee symmetry model. N Am J Sports Phys Ther. 2009.
This article described a new model for ACL rehabilitation, the Knee Symmetry Model. This article introduced this model and how this model been used. Then described details involved in the development and implementation of this rehabilitation program. And they have some data analysis for this model to clear this model is helpful for ACL rehab.

Hohmann E, Tetsworth K, Bryant A. Physiotherapy-guided versus home-based, unsupervised rehabilitation in isolated anterior cruciate injuries following surgical reconstruction, Knee Surg Sports Traumatol Arthrosc , 2011.https://doi.org/10.1007/s00167-010-1386-8
This study is about study the difference between patients who get standard rehabilitation program and patients who had home based rehab program. To get accurate data, 40 patients was participate in this study, they were randomly put in two rehab programs.

AAOS - OrthoInfo: Treatments & Surgeries. N.p., n.d. Web. http://orthoinfo.aaos.org/menus/treatment.cfm#surgical_tx. American Academy of Orthopaedic Surgeons. [Accessed May 19, 2010.]; Surgical Treatments.
This is a website focuses on body's musculoskeletal system injuries, they get lots of reliable information including videos and articles about the rehabilitation.

王, 悦. "医疗技术革新风暴：AR黑科技首次助力癌症精准手术【格隆汇】." 医疗技术革新风暴：AR黑科技首次助力癌症精准手术【格隆汇】. **N.p., 20 July 2016.**

Articles & Websites

Web. 10 Oct. 2016.

http://www.gelonghui.com/p/75705.html

This website is talking about AR help doctor with surgery at the first time.

"10种重新定义人机交互的交互方式（多视频）." **36æ°a. N.p., 13 May 2013. Web. 04 Sept. 2016. http://36kr.com/p/203663.html**

This website is about 10 interactive ways to redefine human-computer interaction. To give some new idea about different platform for interaction.

"人机交互方式将走向何方？." 人机交互方式将走向何方? **13 May 2015. Web. 10 Oct. 2016. http://tech.163.com/15/0513/08/APFVJ67N000948V8.html**

A study of future computer interaction and talk about the deficiencies in the use of computer interaction and top three direction for computer interaction.

龚, 莉. "Pokémon Go风靡全球 AR或将引发医疗应用革命." **CN-healthcare.com, 07 Aug. 2016. Web. 10 Oct. 2016.**

http://www.cn-healthcare.com/article/20160807/content-484783.html

An article about how AR will influence medical treatment and shared some medical cases that used AR technique.

医联. "里约闭幕式中的AR技术可以颠覆医疗新认知." 里约闭幕式中的AR技术可以颠覆医疗新认知**. Yigoonet.com, 23 Aug. 2016. Web. 10 Oct. 2016.**

http://m.yigoonet.com/index.php?&a=show&catid=224&typeid=&id=32220

AR technique in Rio 2016 Summer Olympics and currently the application of AR technology in medical field.

全球VR精选. "除了QQ-AR火炬传递，AR还有更多医疗应用案例." 除了QQ-AR火炬传递，VR资讯-VR指南|YOTOVR官网, **Aug. 2016. Web. 10 Oct. 2016.**

http://www.yotovr.com/six-augmented-reality-healthcare-companies-shaping-future/

This website have six cases in medical treatment field that including AR technique.

Videos

MindovermatterSC. "Knee Exercises - Strengthening Exercise after Knee Surgery 1/8." YouTube. YouTube, 07 Feb. 2012. Web. 17 Oct. 2016. https://www.youtube.com/watch?v=N1si4chpz7E

This video is about a series of knee rehab exercises. And talk about not only strengthening exercises is important, but the perfect movement for the exercises.

Garcia, Djair. "Knee Rehab after ACL Surgery with Coach Djair Garcia." YouTube. YouTube, 14 Mar. 2015. Web. 14 Oct. 2016. https://www.youtube.com/watch?v=Cc-_w6Hjym0

Some types of exercises for knee rehabilitation after ACL surgery as soon as the Stitches are removed.

NIHSeniorHealth. "Physical Therapy Exercises After Knee Replacement." YouTube. YouTube, 01 July 2014. Web. 04 Oct. 2016. https://www.youtube.com/watch?v=yhvgR3TQQr8

A physical therapist helps a woman through various exercises following her knee replacement surgery. Six exercises are shown and described.

PhysioFitnessAust. "ACL Reconstruction: Rehab Program Essentials Seminar | Feat. Tim Keeley | FILEX." YouTube. YouTube, 21 Aug. 2011. Web. 04 Oct. 2016.https://www.youtube.com/watch?v=Yp4eYFald-g

This video described what is the most important thing for patients from one patient's opinion. And showing what's the best way to have better outcome.

Matthew Boes M.D. "Best ACL Exercises | How to Recover From ACL Reconstruction Surgery | Phase 2." YouTube. YouTube, 28 July 2016. Web. 04 Dec. 2016.https://www.youtube.com/watch?v=QzVdEyyliu4

This video is designed to help maximize your recovery following ACL reconstruction surgery. The goals of Phase 2 program for ACL reconstruction rehabilitation are to improve range of motion to normal and restore normal gait pattern. This phase should be conducted within 2-4 weeks following surgery.

DESIGN IDEATION

Design Implementation

To have a clear visual enjoyment for this interactive experience, A perspicuous, effective video prototype will be produced, along with a series of interactive interface design for user and motion graphic design for attractive visual feedback. The plan is to unify the results from research and the conclusions I came up into an interactive design that will be helpful for target audience. With the video prototype production, I will also have social networking sites and personal website to help me share this platform and get feedback.

Design Methodology

The primary objective of the project is to design an interface for an interaction device for people doing rehab after knee surgery. A demonstration of this interactive experience is in the form of an animated video, displaying its details and capabilities. To create this demo requires learning about database management, information graphics, user interaction, user experience, motion graphics, interactivity and augmented reality, and related interaction/interface design.

Through comprehensive planning, this project would achieve useful and beneficial investigation method provides a useful interactive experience that knee surgery patients will use and enjoy.

DESIGN IDEATION

Design Overview

Visual style is one of the most important elements of the whole design. The objective is to have a visual identity system that has good visibility, attractive and easy to identify.

As the most direct and intuitive communication visual performance with users, interface Design is the basic design parts for this interactive experience. The purpose for the interface design is to help user quickly become familiar with this new interactive experience and at the same time have a comfortable interactive flow.

To provide a better demonstration for how the interactive experience works, It was necessary to create a video introduction to show the process and interactive layout. Video Shooting was the first stage to start.

After all steps are done, the last stage is the final design. This thesis project has an interface design and video prototype, and it will be seen by many individuals. Users will give feedback through various ways.

VISUAL DEVELOPMENT

Visual Style

Goals:

The main purpose of the visual style of the project is to have an good interactive experience. This will help users achieve a better understanding for this project and get familiar with it quickly, and it will help them to have a complete, comfortable, meaningful experience.

Attributes:

Succinct

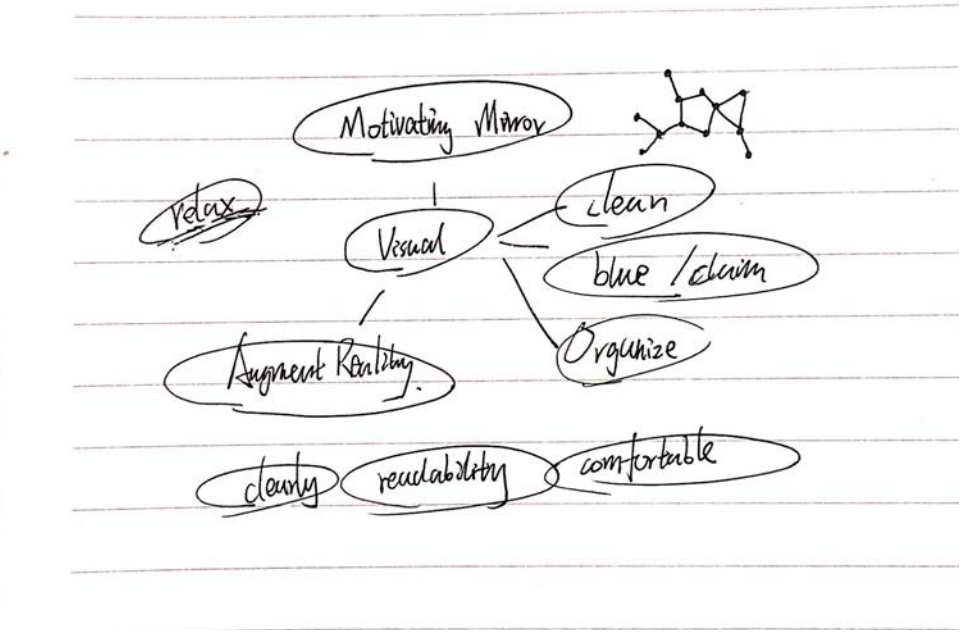
Clean

Organize

Interactivity

Guidance

Brainstorming:



VISUAL DEVELOPMENT

Visual Style

Name:

Motivating Mirror

The reason why I chose Motivating Mirror as the name of this interactive platform is not only that it includes the main medium of expression of the project, but also expresses the functionality of the project. As a title, it comes straight to the point, it is highly readable and intense.

Color Exploration:

Primary:

#D5DFE1 #D7E4F4 #7292A9 #2E5771

Secondary:

#EFFFD8 #F9F18C #FE0000

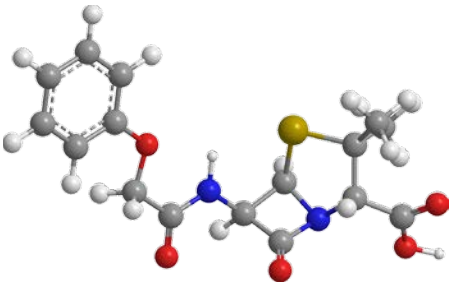
Logo Development

Along with the name of this project, the letter “M” will be the main shape of the logo. After having the main element, I came up with several different concepts to match the product position. In order to have a better visual effect, I added a pattern related to skeletal structure to make the logo more consistent with the product’s image.

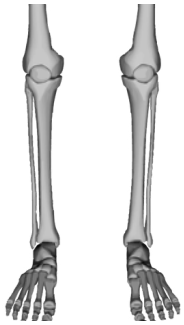
Logo Inspiration:

Letter M

Restructuring



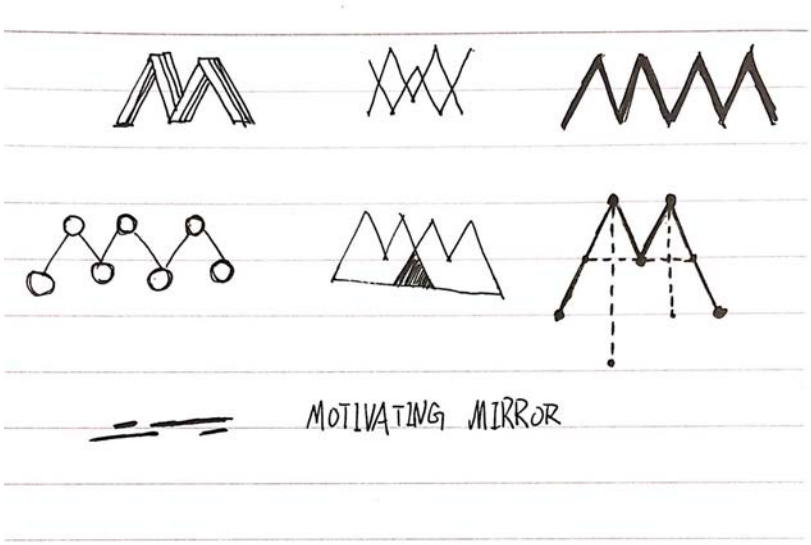
Skeletal structure



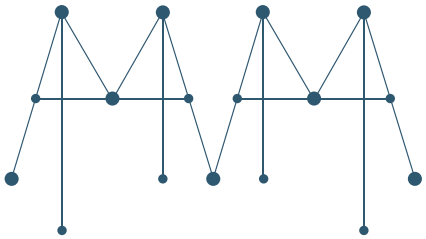
VISUAL DEVELOPMENT

Logo Development

Sketches



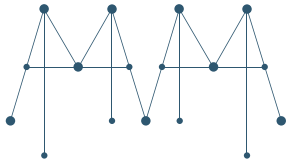
Graphics Development

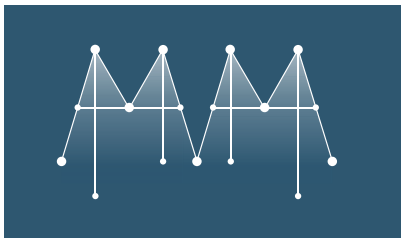


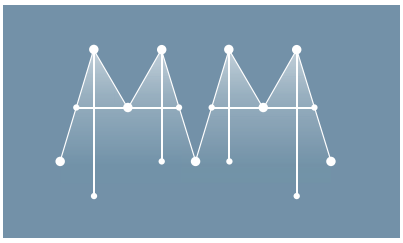
VISUAL DEVELOPMENT

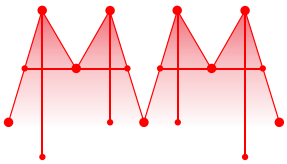
Logo Development

Color study









Interface Design

Goals:

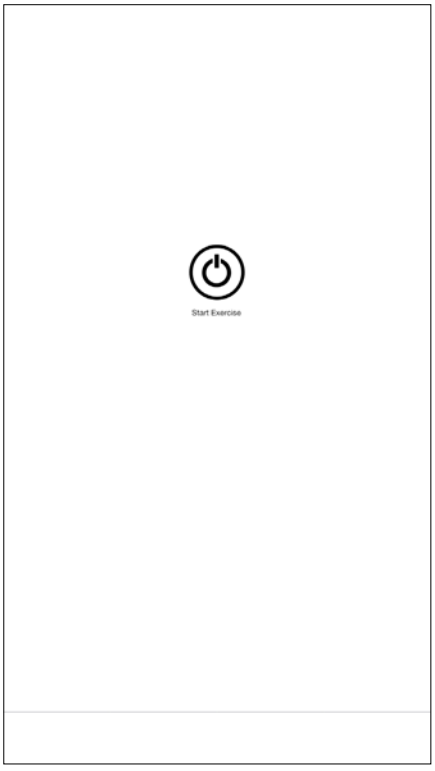
This user interface is designed for patients who need to perform rehabilitation exercises for knee surgery, it is designed to provide a more effective and attractive choice for patients.

In order to meet the needs of patients, the interface design is simple, readable, relaxing and educational.

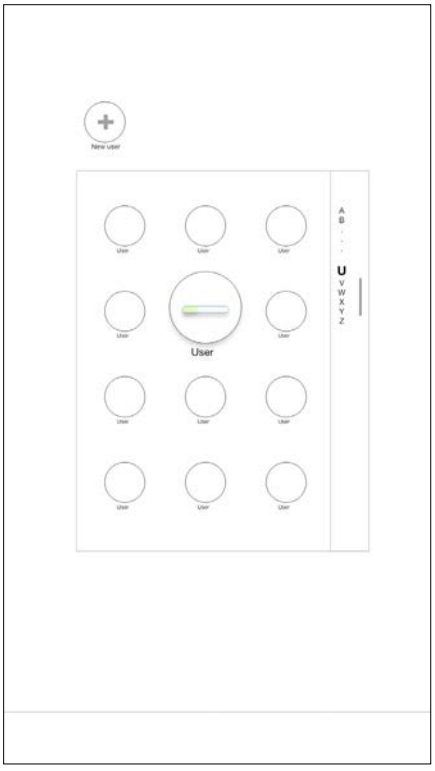
Visual Development:

Sketches:

Start page:



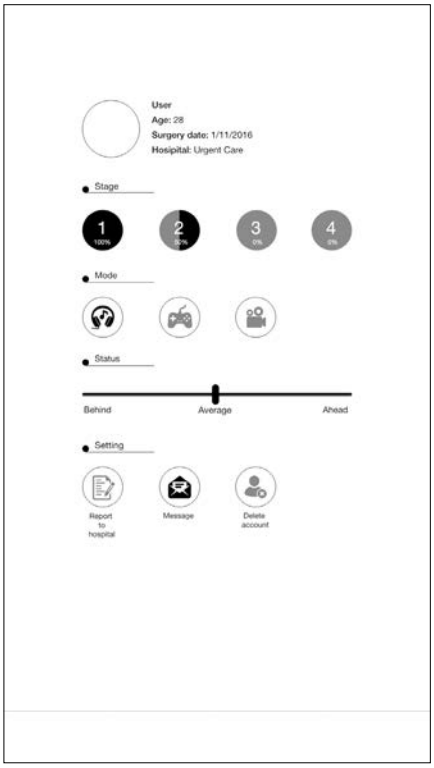
Choose user:



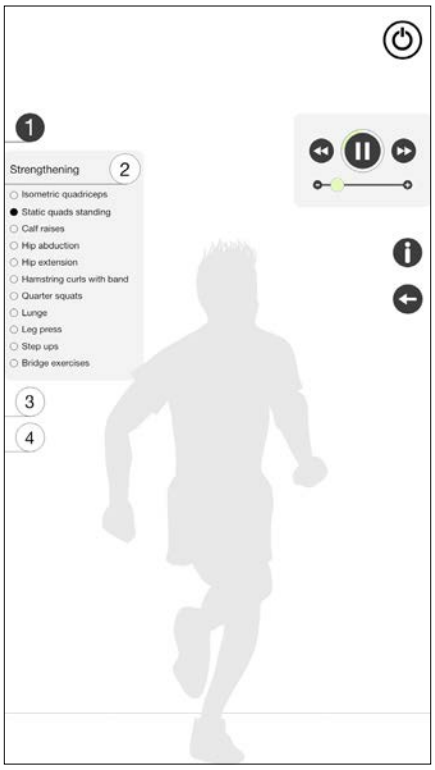
Interface Design

Sketches:

Homepage:



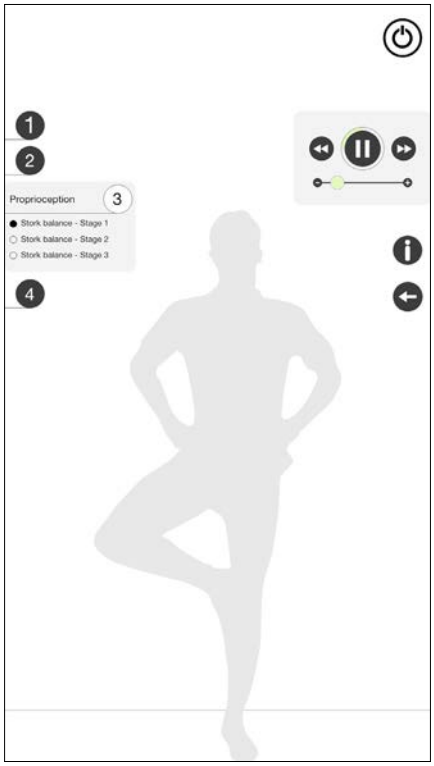
Exercise page:

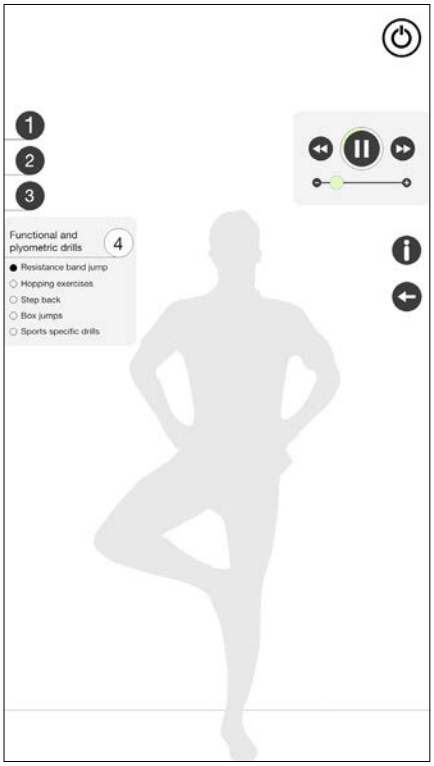


Interface Design

Sketches:

Exercise page:

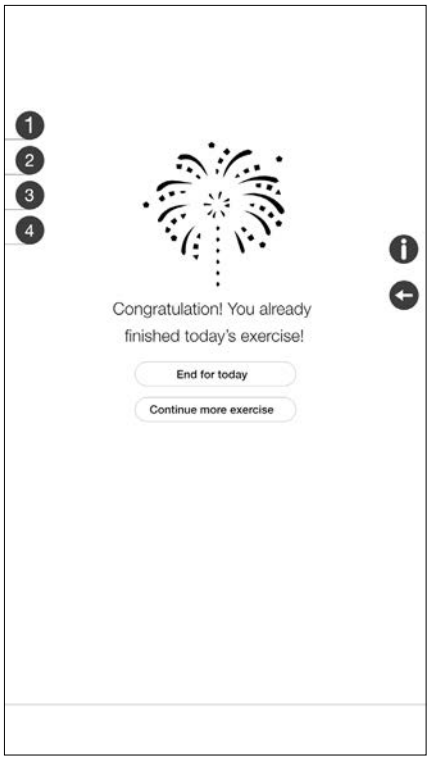


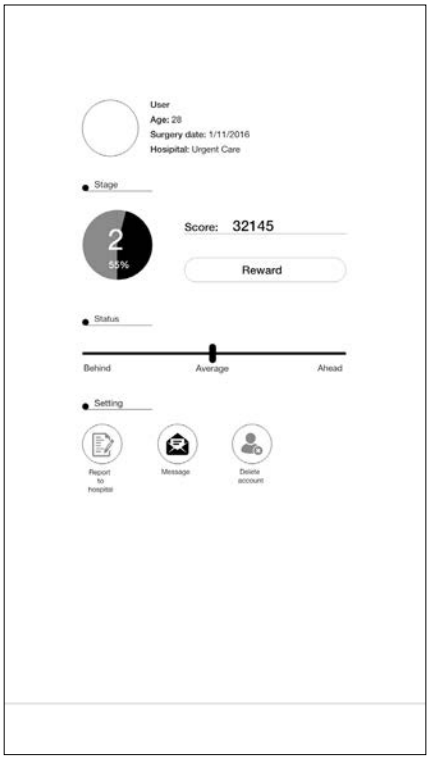


Interface Design

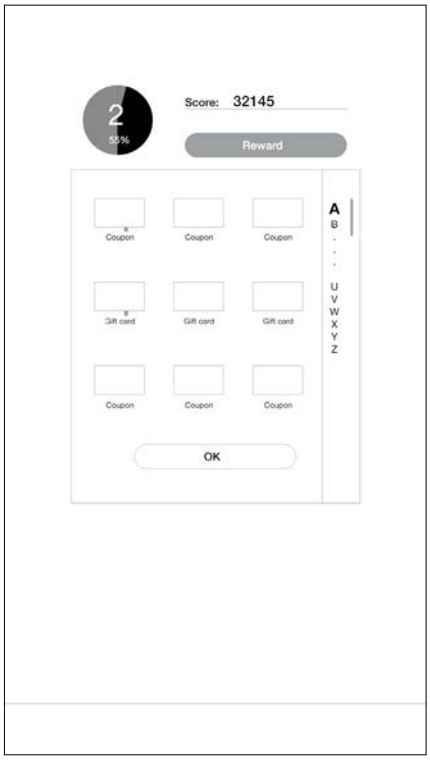
Sketches:

Finish exercise page:





Reward page:



Video shooting

Goals:

The purpose of video shooting is to help the interface design visualized. To do that, the person in the video will interact with mirrors that do not actually have the interface design on it, then to match the interface motion path with the video.

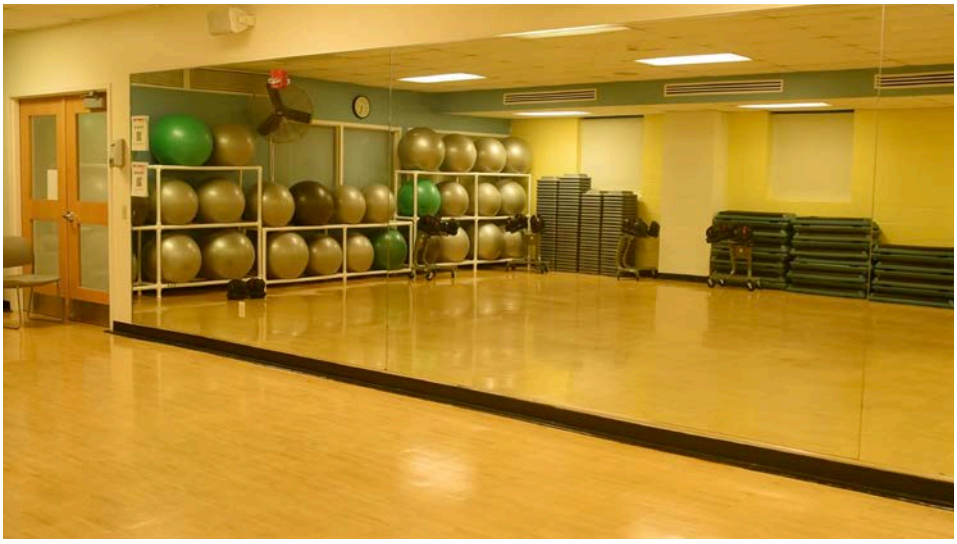
Equipment:

NIKON D810

Process:

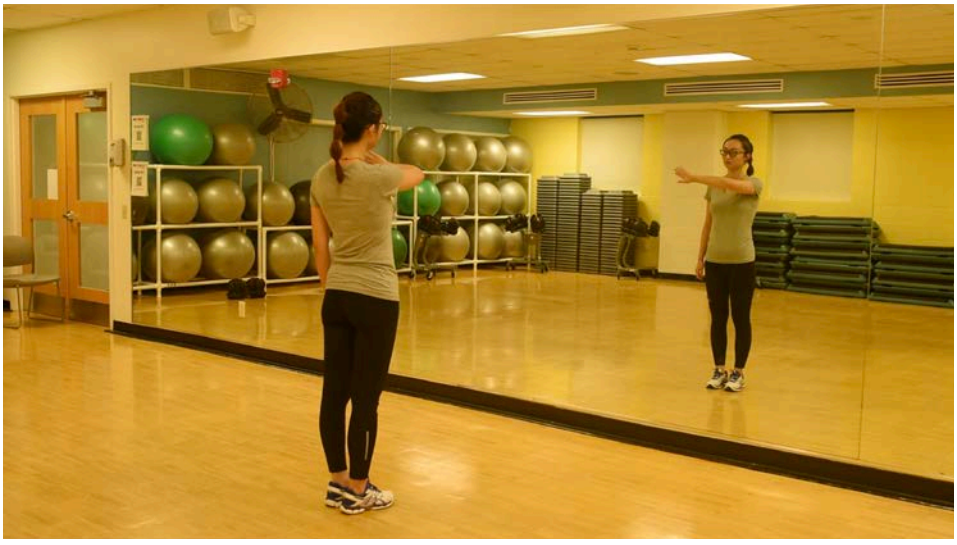
Scene:

Location: RIT dance classroom



Video shooting

Video clips:



Logo Design

Software:

Adobe Illustrator CC

Typeface:

Helvetica Neue Light

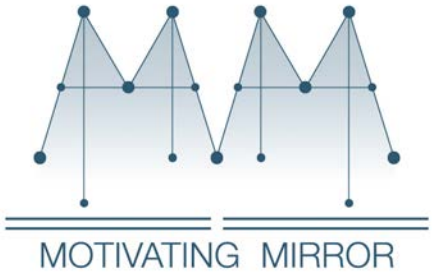
AaBbCcDdEe0123,./!

Color choice:

#2E5771

#7292A9

Final Design:



Interface Design

Software

Adobe Illustrator CC

Adobe Experience Design CC

Typeface

Helvetica Neue Light

AaBbCcDdEe0123,./!

Helvetica Neue Regular

AaBbCcDdEe0123,./!

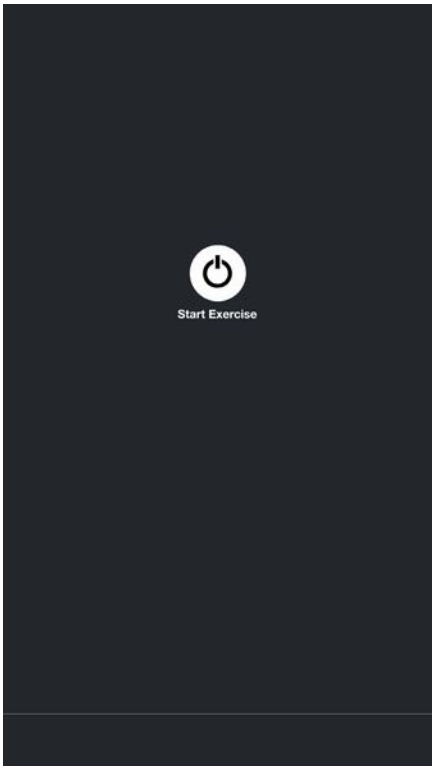
Helvetica Neue Medium

AaBbCcDdEe0123,./!

Interface Design

Final Design

Stand by | Choose users:

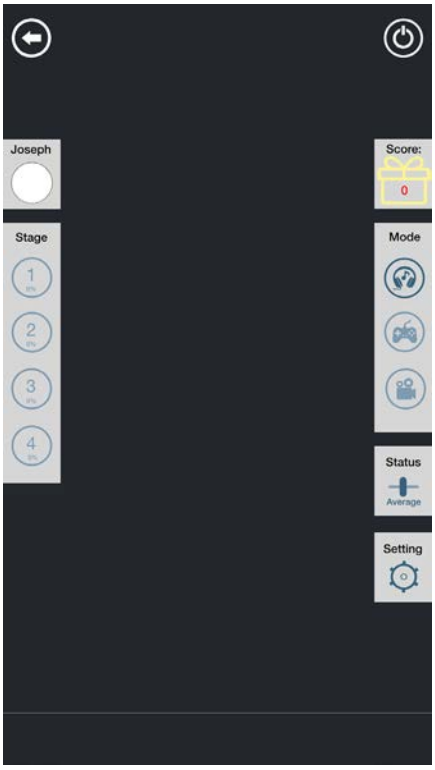


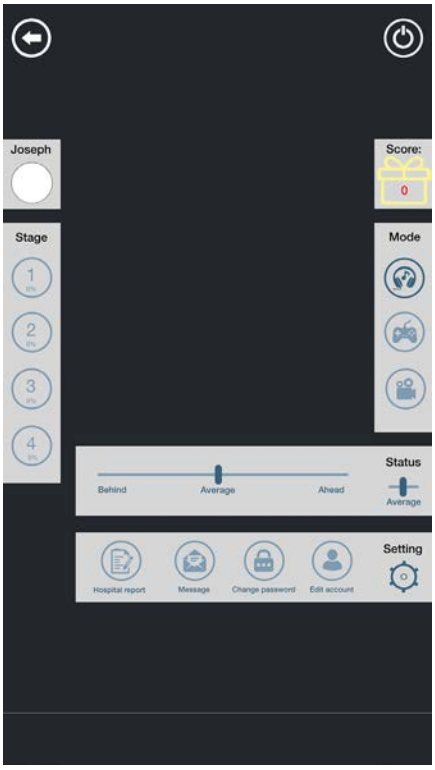
Interface Design

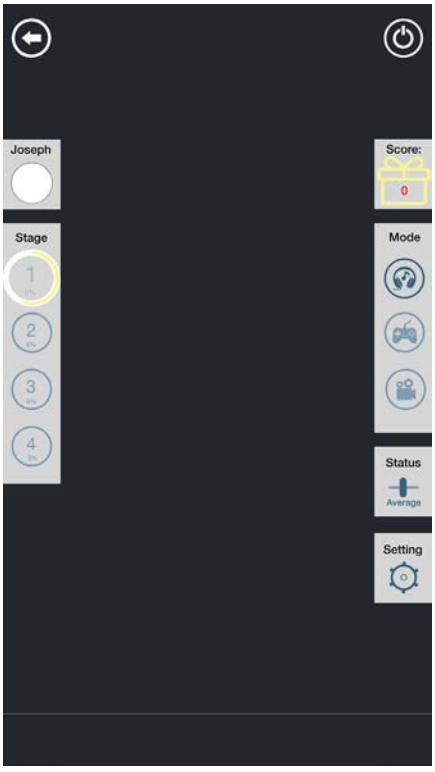
For New Users:

Interface Design

For New Users:

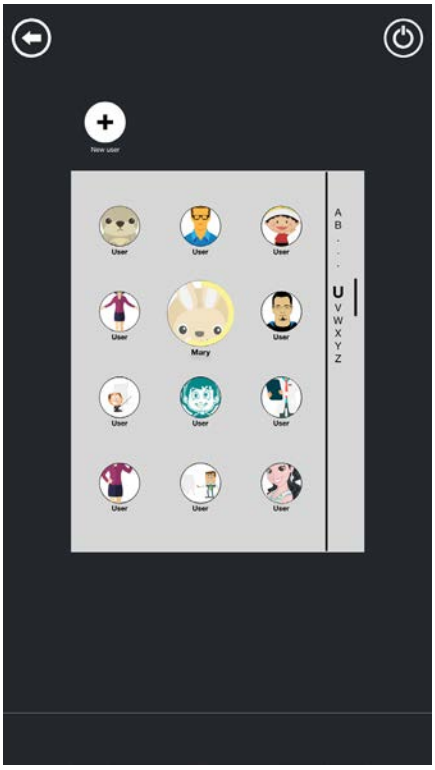






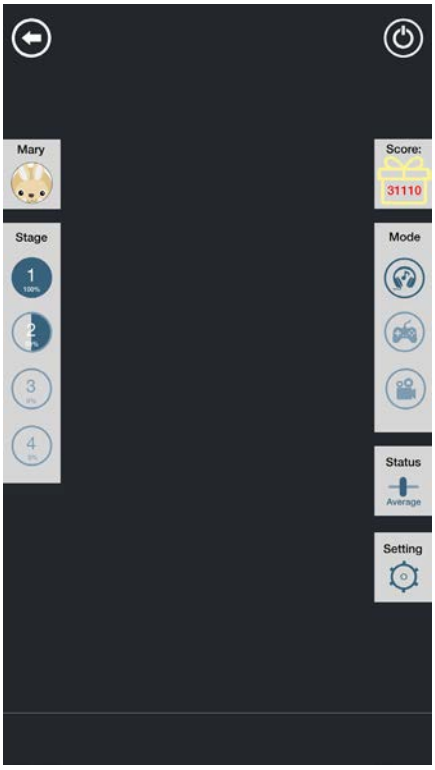
Interface Design

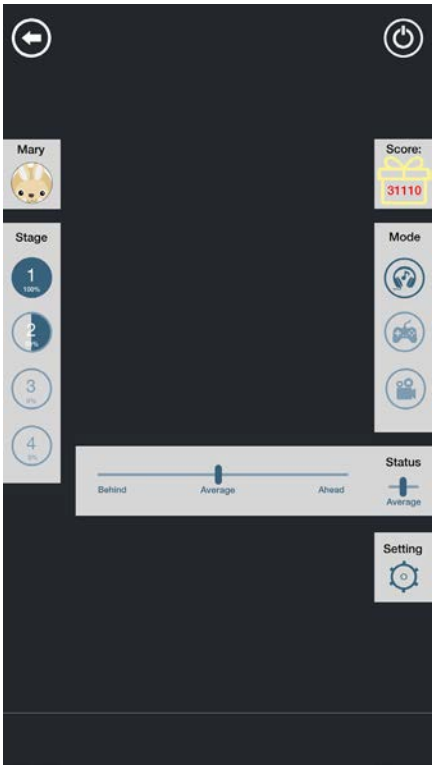
For Returning Users:

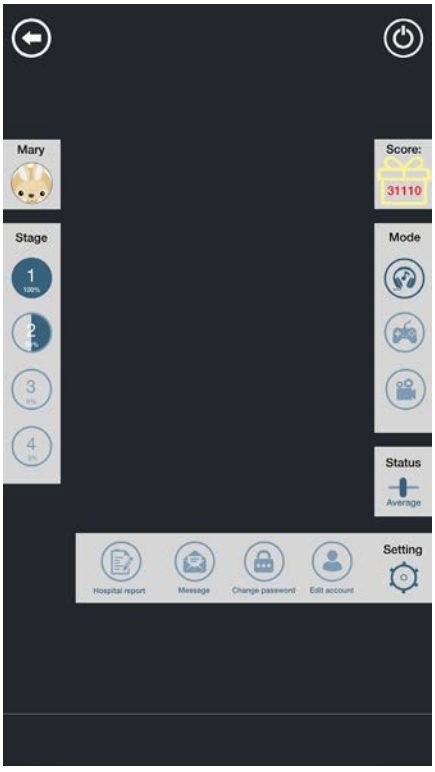


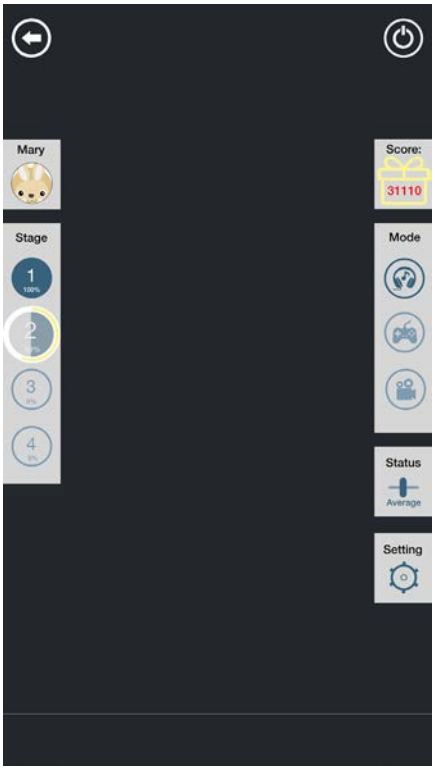
Interface Design

For Returning Users:



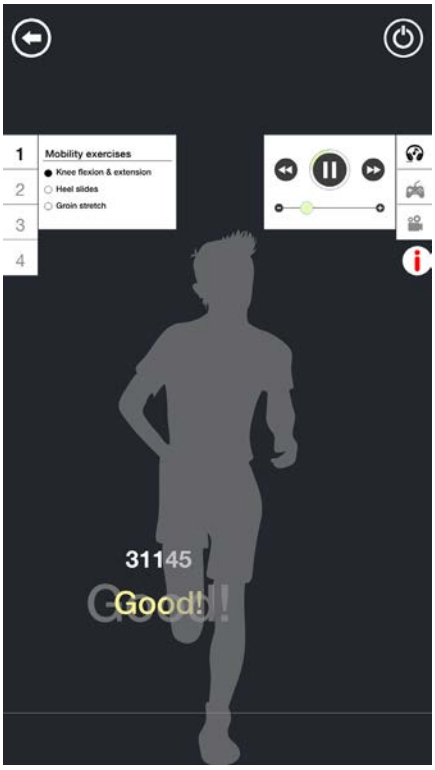


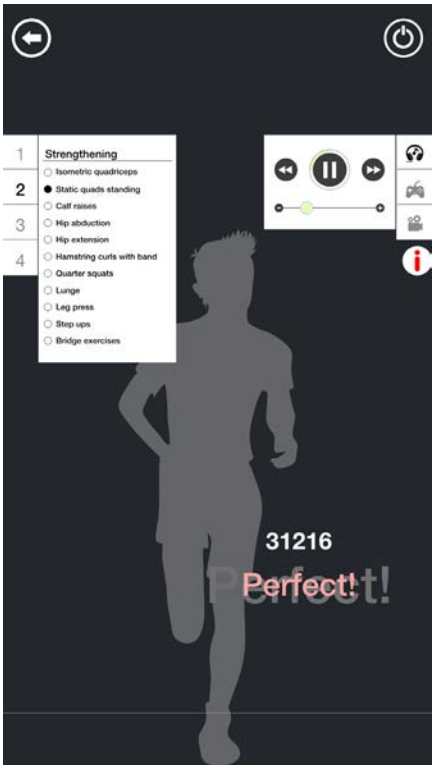


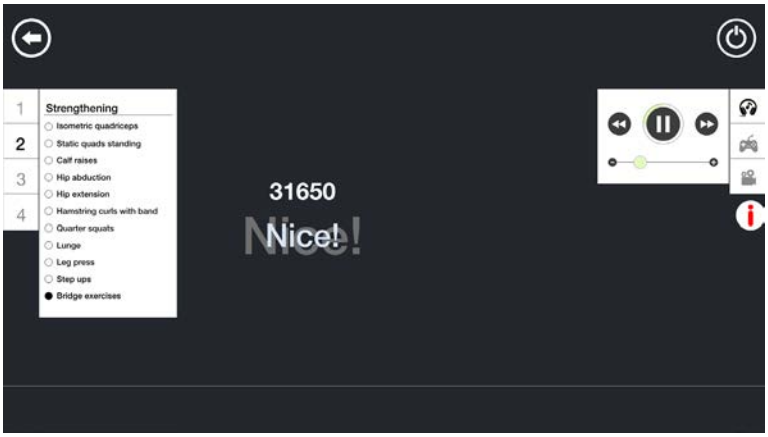


Interface Design

Exercise part:

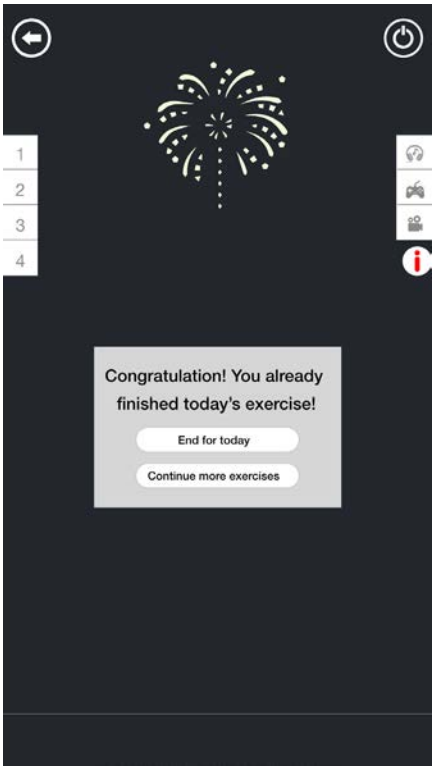






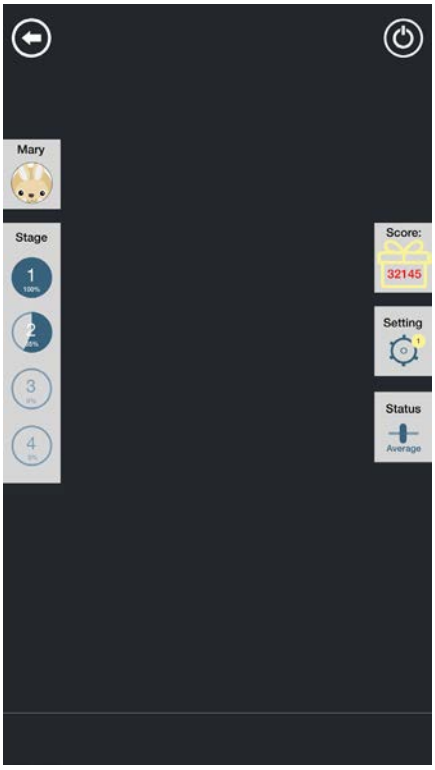
Interface Design

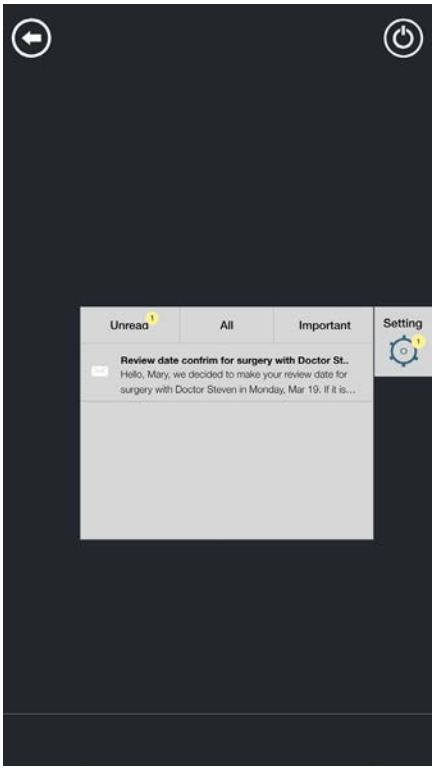
Exercise part:



Interface Design

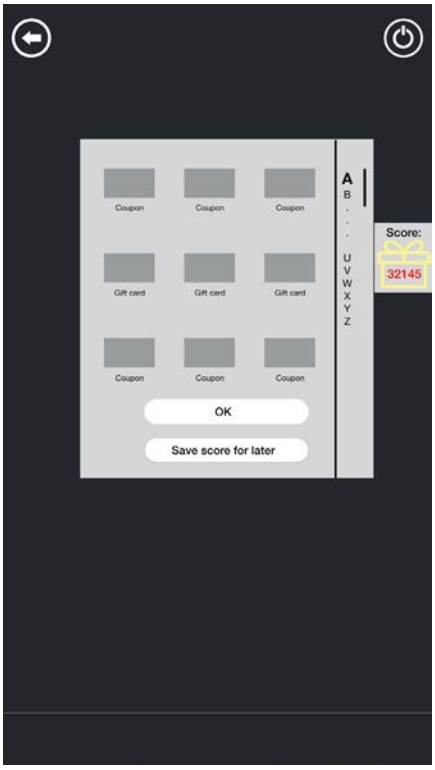
Message part:

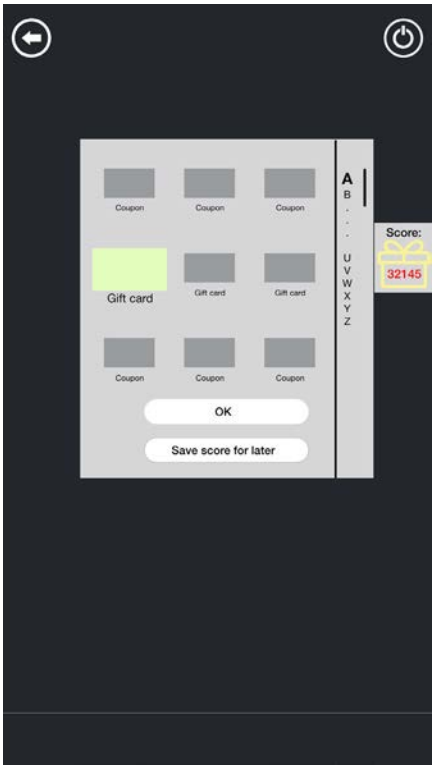


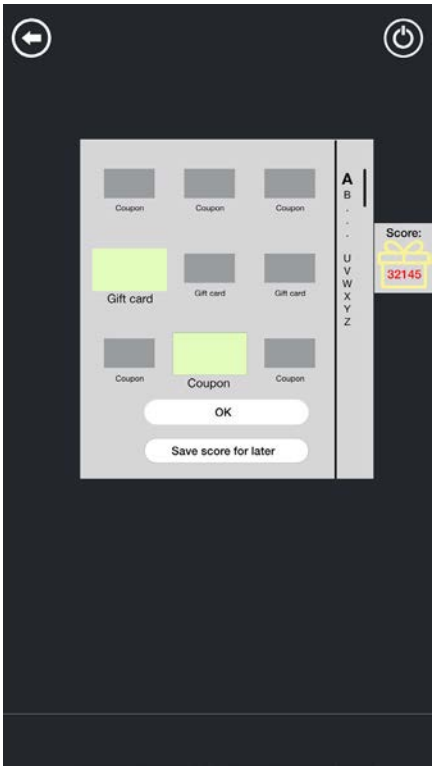


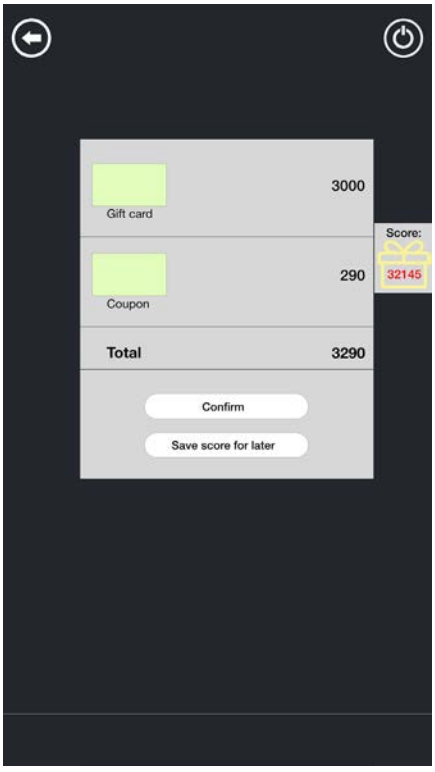
Interface Design

Redeem part:



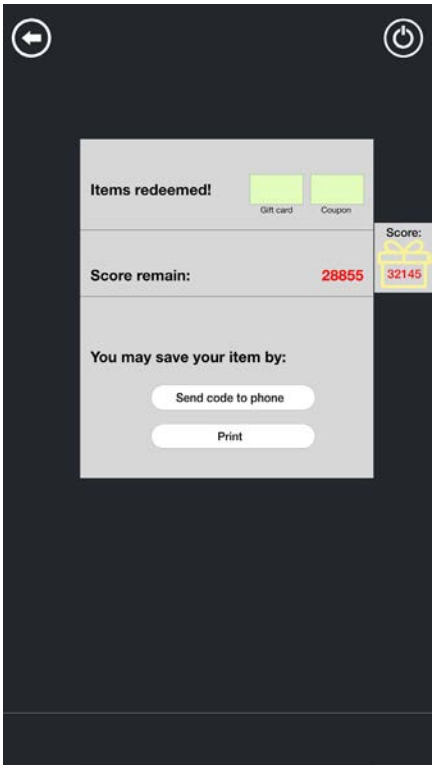


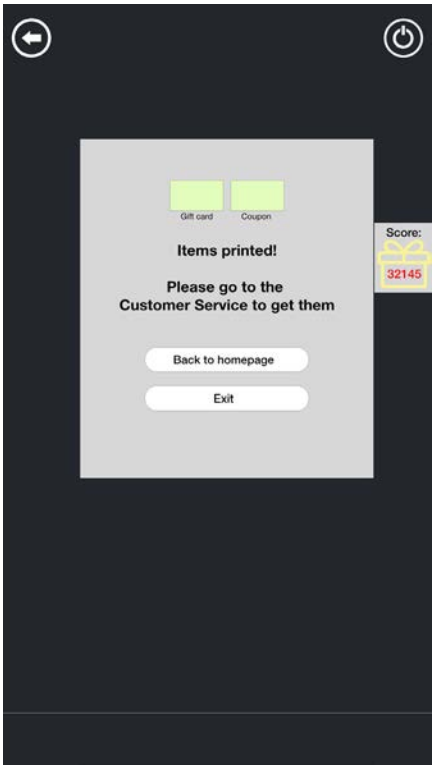


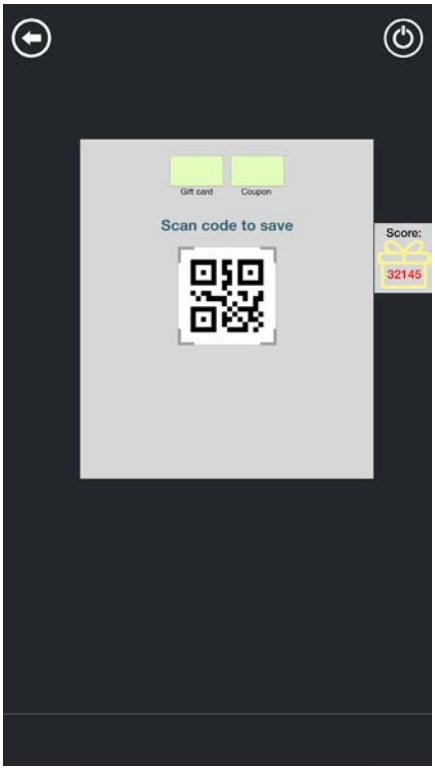


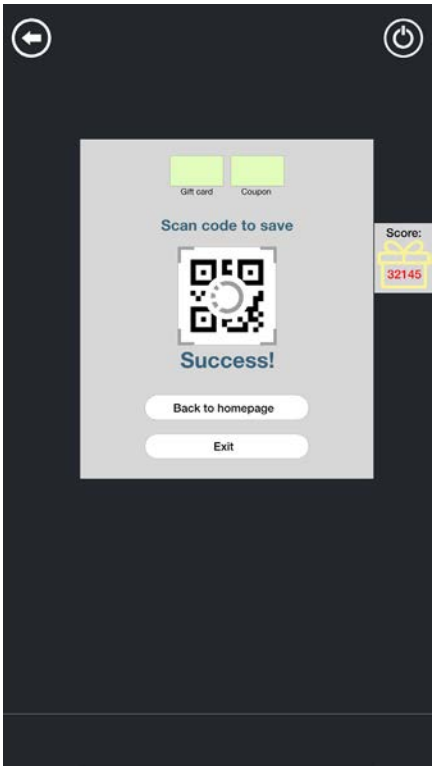
Interface Design

Redeem part:









Video Design

Software

Adobe Illustrator CC

Adobe After Effects CC

Typeface

Helvetica Neue Light

AaBbCcDdEe0123,./!

Helvetica Neue Regular

AaBbCcDdEe0123,./!

Helvetica Neue Medium

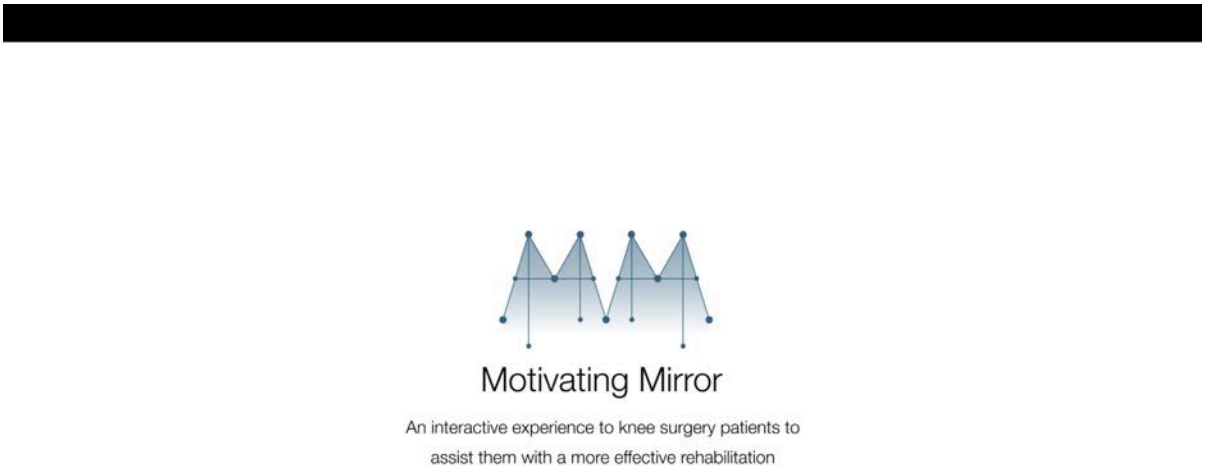
AaBbCcDdEe0123,./!

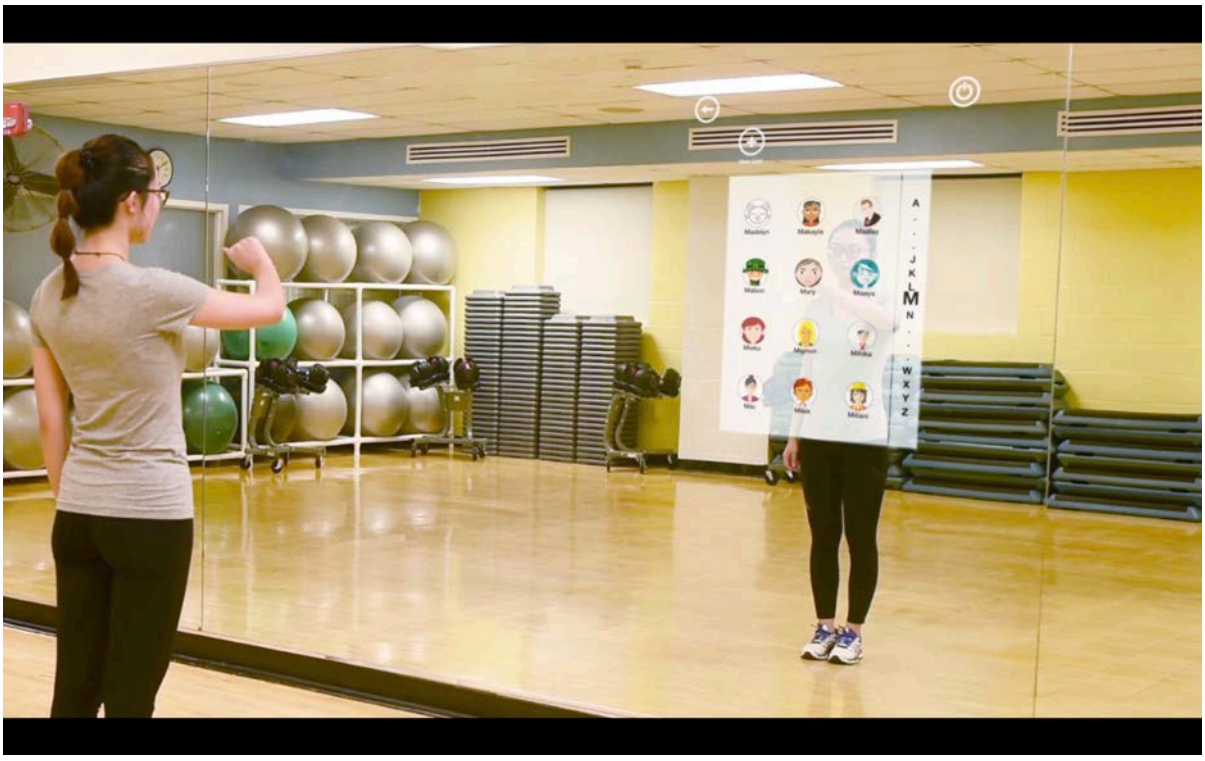
FINAL DESIGN

Video Design

Final Design:

Video link: https://vimeo.com/218472552



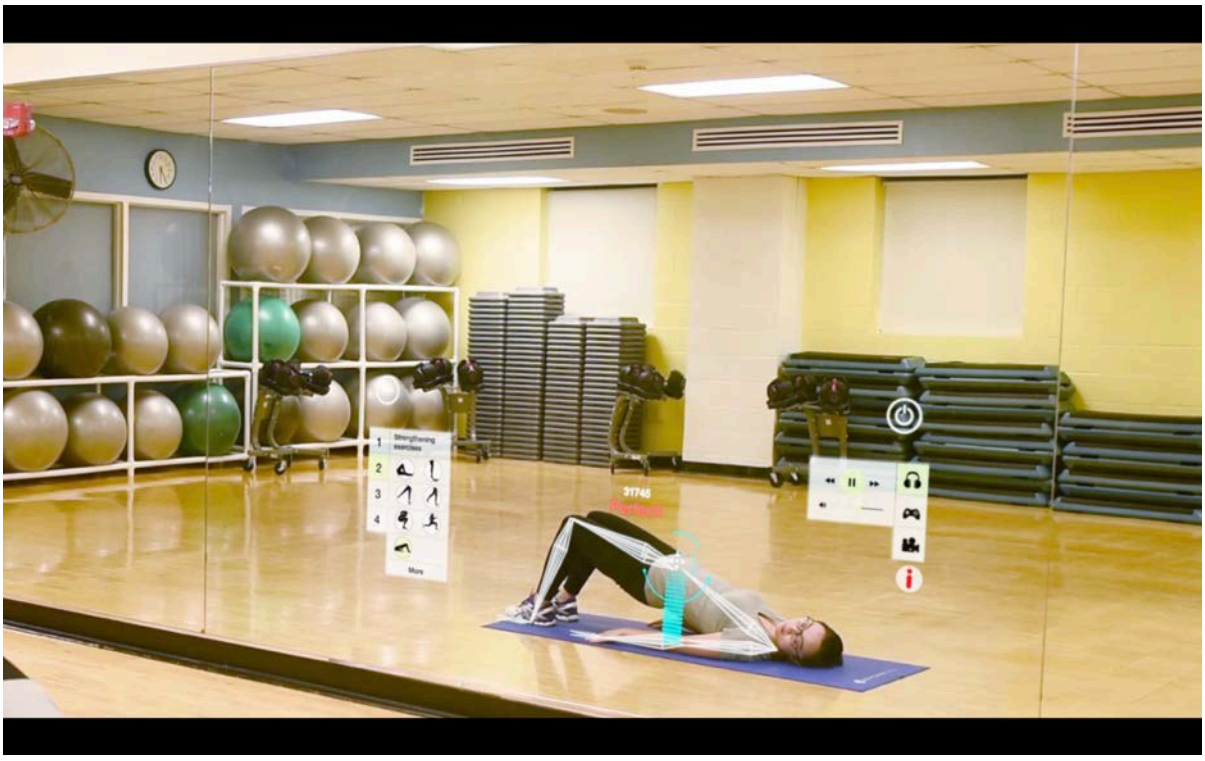


FINAL DESIGN

Video Design

Final Design:

Video link: https://vimeo.com/218472552

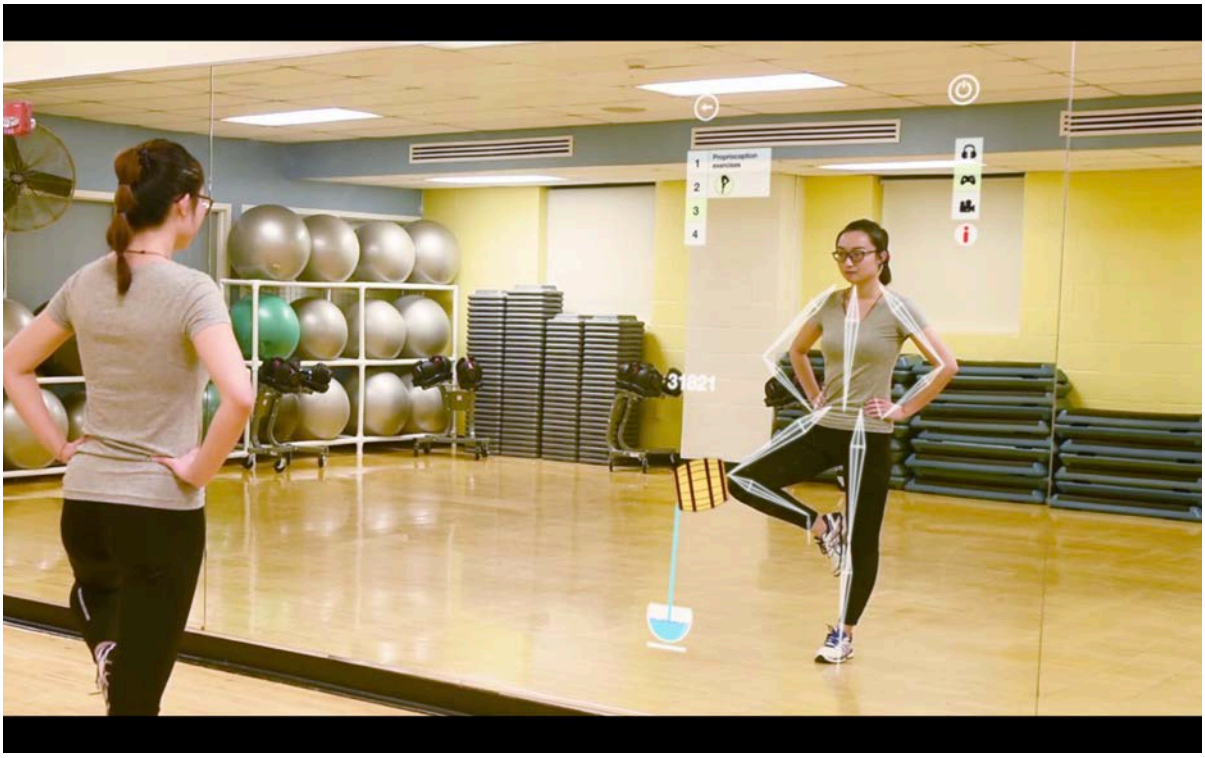


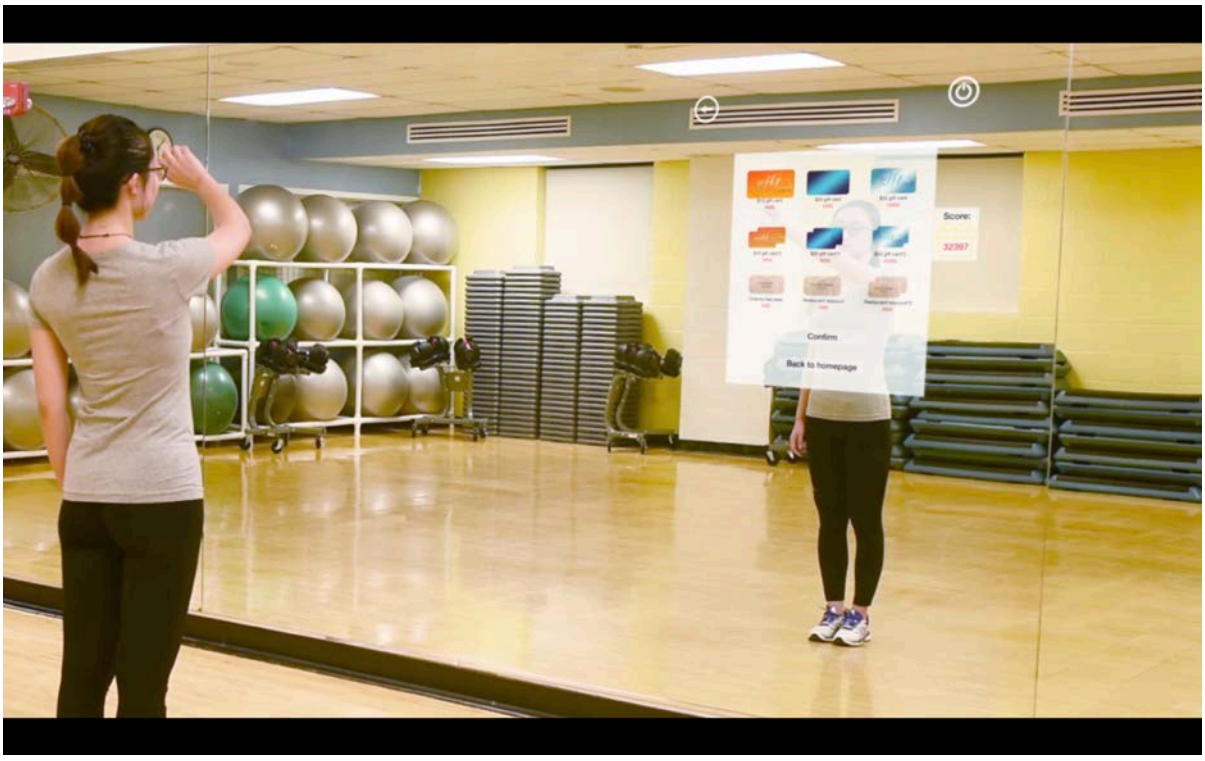
FINAL DESIGN

Video Design

Final Design:

Video link: https://vimeo.com/218472552





MFA Thesis Show

Location:

James Booth Hall 07a

Room1305

Rochester Institute of Technology

Questionnaire :

Motivatiing Mirror

Age

☐ 20-35 ☐ 35-45 ☐ 45-55 ☐ Other

Gender

☐ Male ☐ Female

1. Have you been through knee surgery and get to know the rehab exercises?

☐ Yes ☐ No

2. What do you think about these rehab exercises?

Boring Excited

1	2	3	4	5	6	7	8	9	10

3. What do you think if there's some interactive mirror feedback while you are doing those rehab exercises?

Not interested Interested

1	2	3	4	5	6	7	8	9	10

Feel free to go through the digital prototype video and play with the interface

4. How likely is it that you would recommend this interface to a friend or a company?

Not at all likely Extremely likely

1	2	3	4	5	6	7	8	9	10

5. Overall, how would you rate this interface?

☐ Excellent ☐ Very good ☐ Good ☐ Fair ☐ Poor

6. How helpful do you think if patients have this interface while you doing rehab exercises?

☐ Extremely helpful ☐ Very helpful ☐ Somewhat helpful ☐ Not so helpful ☐ Not at all helpful

7. How satisfied are you with the reliability of this interface?

☐ Extremely satisied ☐ Very satisied ☐ Somewhat satisied ☐ Not so satisied ☐ Not at all satisied

8. How satisfied are you with the look and feel of this interface?

☐ Extremely satisied ☐ Very satisied ☐ Somewhat satisied ☐ Not so satisied ☐ Not at all satisied

9. How satisfied are you with the typeface readability and design of this interface?

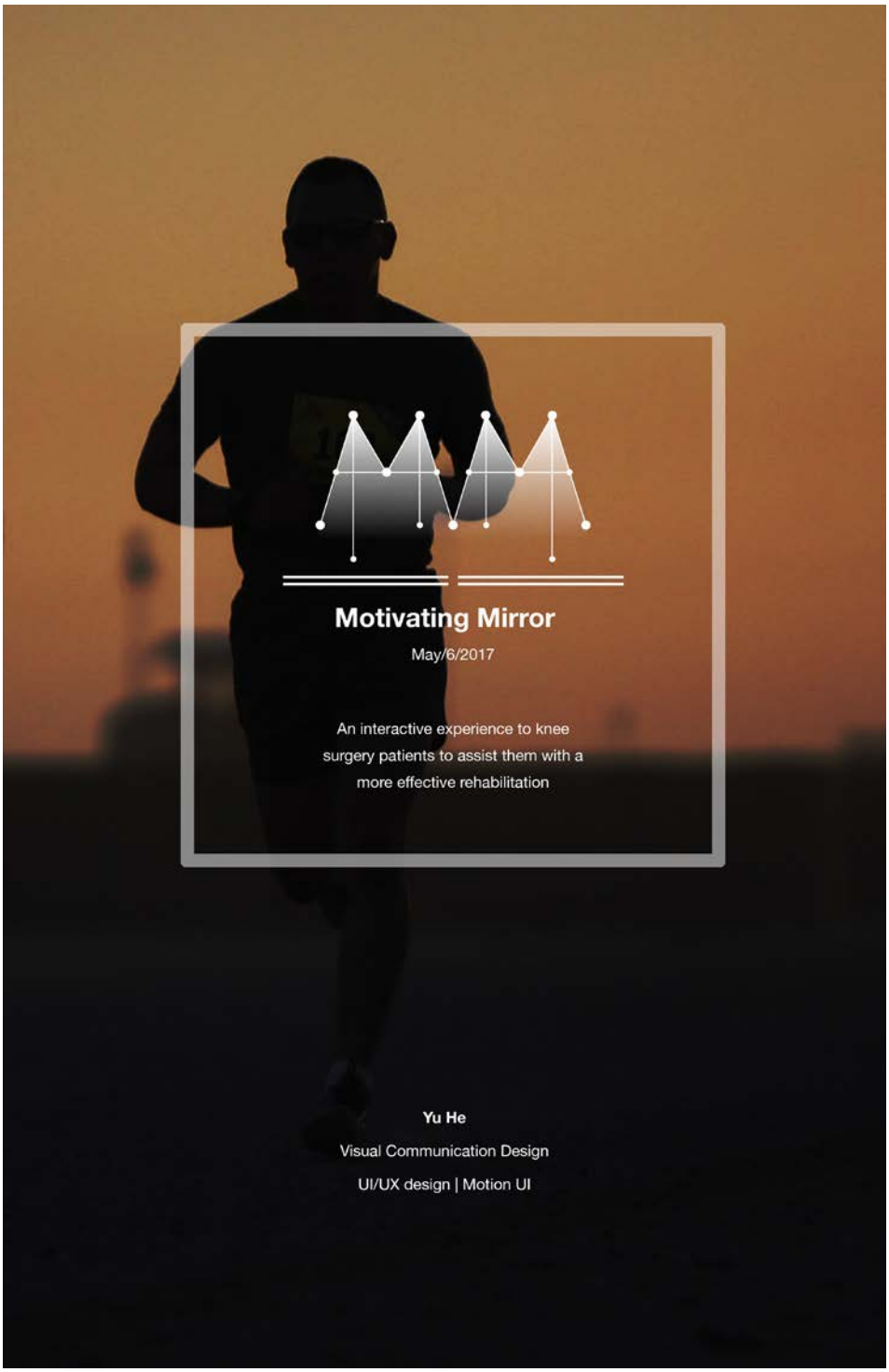
☐ Extremely satisied ☐ Very satisied ☐ Somewhat satisied ☐ Not so satisied ☐ Not at all satisied

10. Comment (if there's no enough space, feel free to write it on the back):

FINAL DESIGN

MFA Thesis Show

Poster Design:



Being aware of the needs of a particular group of people, it is a very challenging task to propose a technical solution aimed at specific needs. I was inspired by the observation of daily life and the experiences of people around me. The completion of rehabilitation therapy and the insufficiency of the final results of rehabilitation is a practical problem that is worth serious study. The main problem is the lack of mobility and the lack of good rehabilitation experience. Although patients understand that rehabilitation is the only way to fully recover after surgery, it is a question worth pondering that the final outcome of tradition rehabilitation is not ideal.

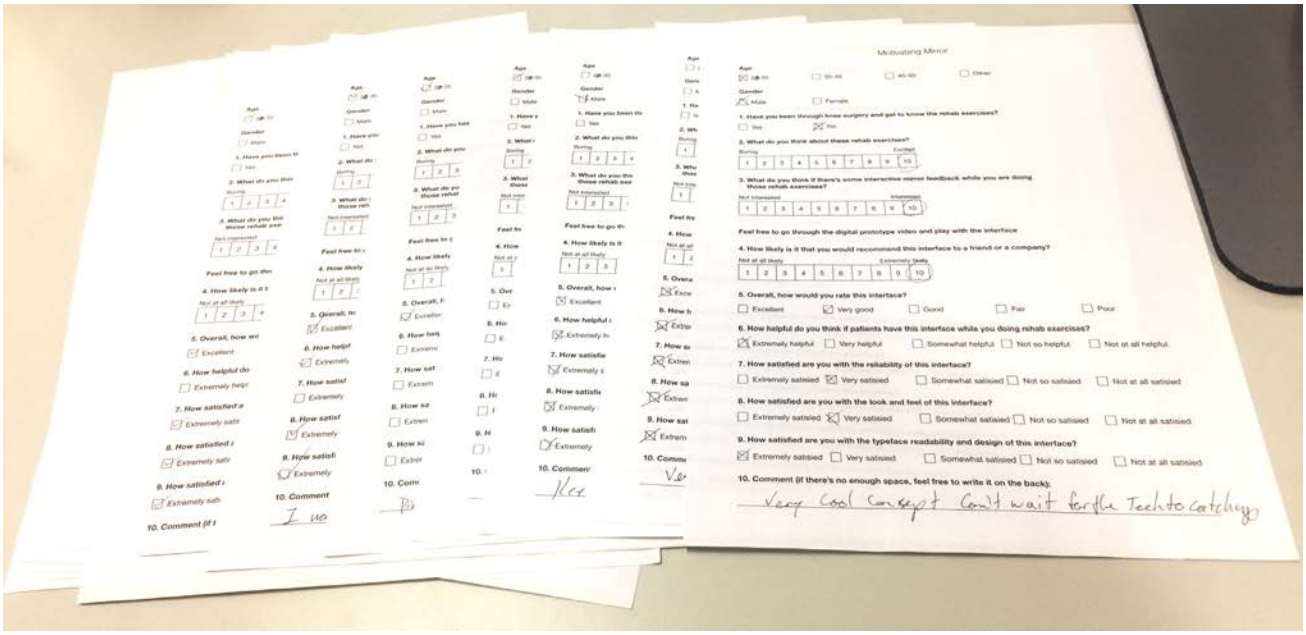
The goal of this project was to motivate knee surgery patients to have a better interactive experience while they are doing rehab exercises. In order to achieve this goal, I designed an AR interactive experience, hoping to encourage and attract patients to actively participate in the rehabilitation exercise, and to help users get good rehabilitation results.

The project involves the comprehensive research and analysis of the conception, strategic planning, program evaluation and implementation. The final design, along with the user's curiosity, should hopefully be able to attract users to actively participate in rehabilitation. In addition, the project, with its innovative interface, provides a new way of thinking, a different platform.

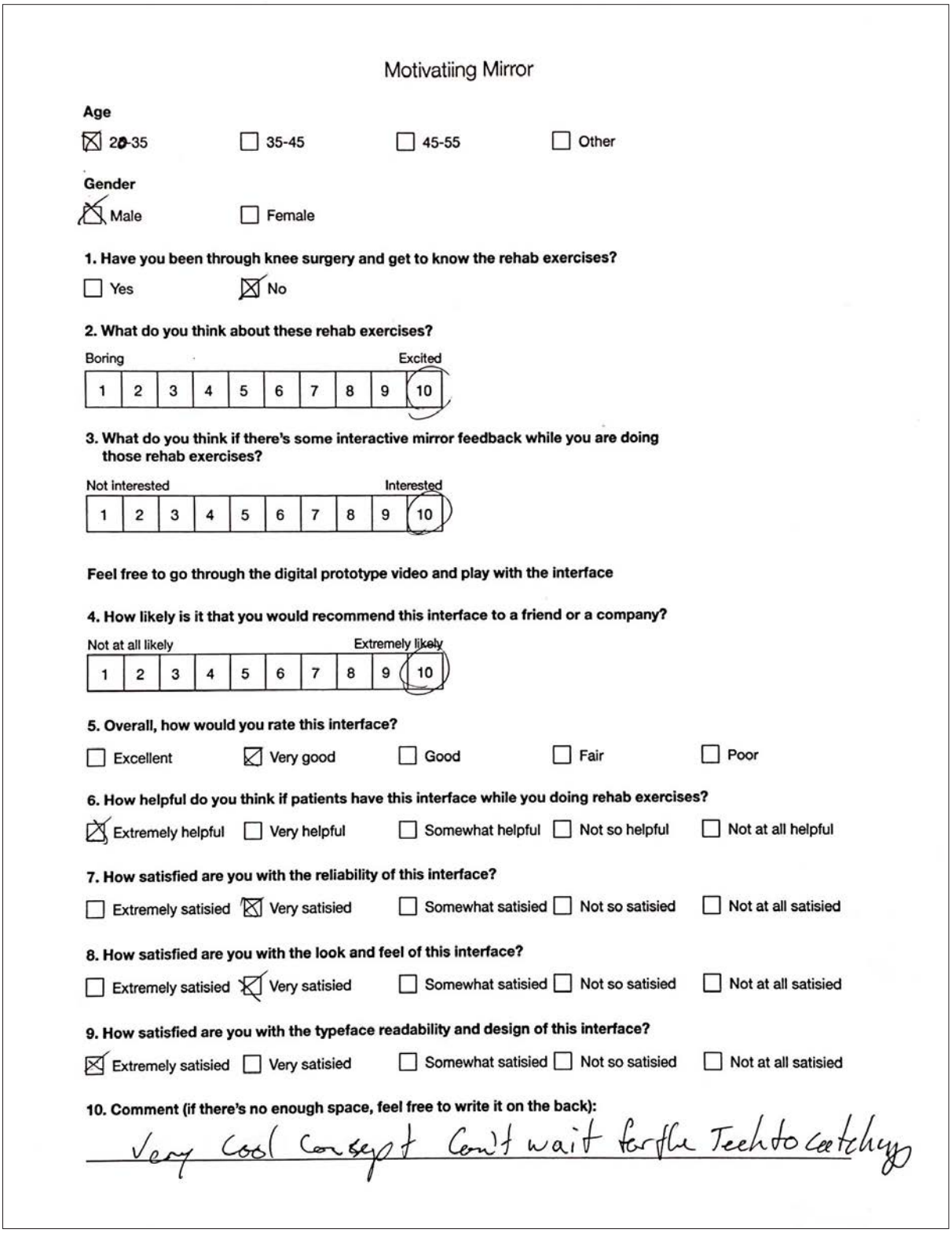
It is delightful that audiences reacted positively. It is not only the target audience that is appreciative of this design, but it also has positive support from the relatives and friends of the target audience. The questionnaire I did during Imagine RIT revealed that participants were interested in the project and thought it was a design worthy of real development. In addition, the video prototype is a more intuitive way to express the purpose of this project to the audience. They are looking forward to seeing the project visualized.

Through this thesis project, I gained new design experience of Augmented Reality, and gained knowledge in related fields, and broadened my horizons. This is also a design project that is completely different from the previous experience I have. To understand the user needs and to design suitable interactive interface based on users' needs will be my continuous goal in the future.

A: Imagine RIT Surveys



A: Imagine RIT Surveys



Motivatiing Mirror

Age

☒ 20-35 ☐ 35-45 ☐ 45-55 ☐ Other

Gender

☒ Male ☐ Female

1. Have you been through knee surgery and get to know the rehab exercises?

☐ Yes ☒ No

2. What do you think about these rehab exercises?

Boring — Excited

1	2	3	4	5	6	7	8	9	10

3. What do you think if there's some interactive mirror feedback while you are doing those rehab exercises?

Not interested — Interested

1	2	3	4	5	6	7	8	9	10

Feel free to go through the digital prototype video and play with the interface

4. How likely is it that you would recommend this interface to a friend or a company?

Not at all likely — Extremely likely

1	2	3	4	5	6	7	8	9	10

5. Overall, how would you rate this interface?

☐ Excellent ☒ Very good ☐ Good ☐ Fair ☐ Poor

6. How helpful do you think if patients have this interface while you doing rehab exercises?

☒ Extremely helpful ☐ Very helpful ☐ Somewhat helpful ☐ Not so helpful ☐ Not at all helpful

7. How satisfied are you with the reliability of this interface?

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8. How satisfied are you with the look and feel of this interface?

☐ Extremely satisied ☒ Very satisied ☐ Somewhat satisied ☐ Not so satisied ☐ Not at all satisied

9. How satisfied are you with the typeface readability and design of this interface?

☒ Extremely satisied ☐ Very satisied ☐ Somewhat satisied ☐ Not so satisied ☐ Not at all satisied

10. Comment (if there's no enough space, feel free to write it on the back):

Very Cool Concept Can't wait for the Tech to catch up

A: Imagine RIT Surveys

Motivatiing Mirror

Age

☐ 20-35 ☐ 35-45 ☒ 45-55 ☐ Other

Gender

☐ Male ☒ Female

1. Have you been through knee surgery and get to know the rehab exercises?

☐ Yes ☒ No

2. What do you think about these rehab exercises?

Boring — Excited

1	2	3	4	5	6	7	8	9	(10)

3. What do you think if there's some interactive mirror feedback while you are doing those rehab exercises?

Not interested — Interested

1	2	3	4	5	6	7	8	9	(10)

Feel free to go through the digital prototype video and play with the interface

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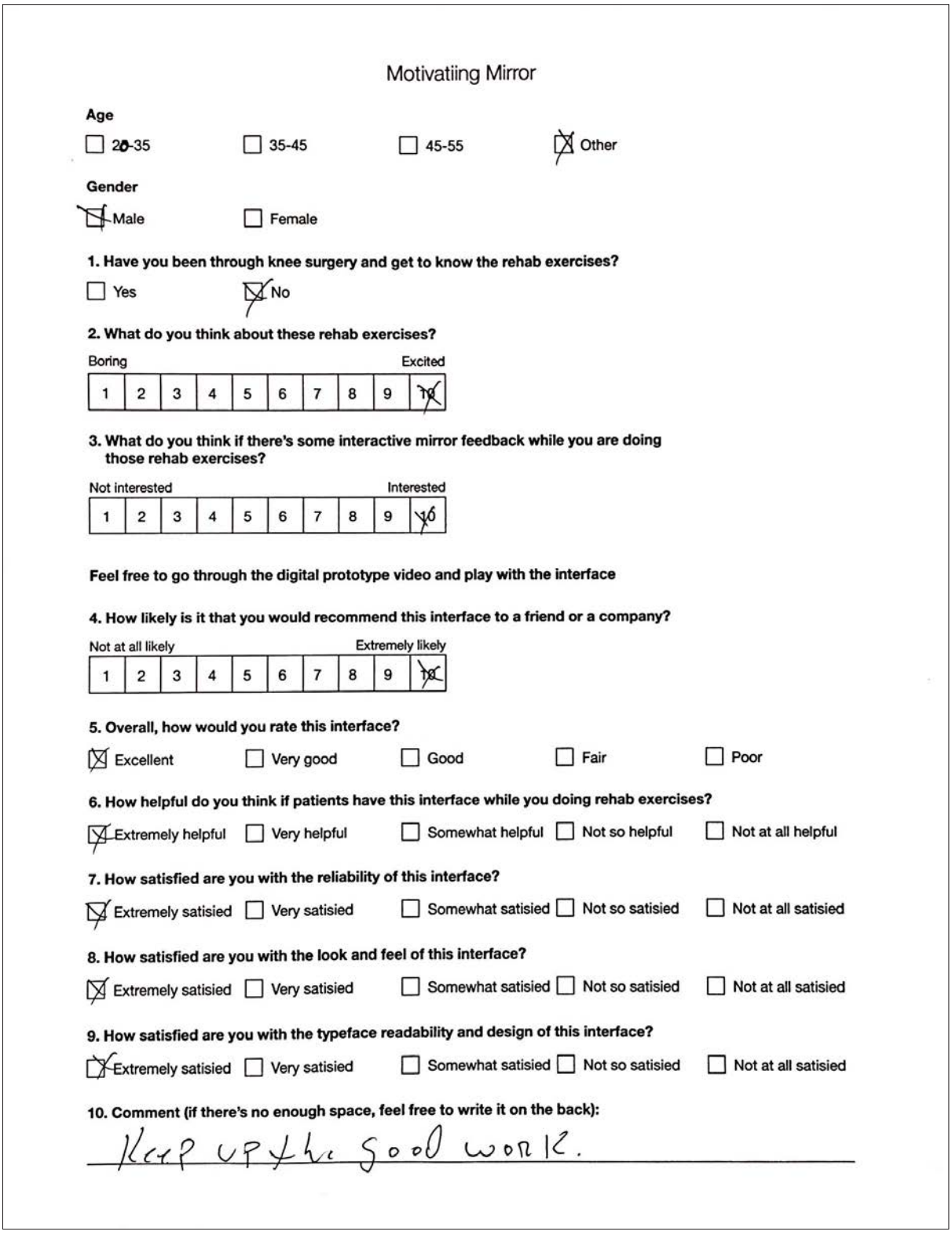
9. How satisfied are you with the typeface readability and design of this interface?

☒ Extremely satisied ☐ Very satisied ☐ Somewhat satisied ☐ Not so satisied ☐ Not at all satisied

10. Comment (if there's no enough space, feel free to write it on the back):

Very creative idea!

A: Imagine RIT Surveys



Motivatiing Mirror

Age

☐ 20-35 ☐ 35-45 ☐ 45-55 ☒ Other

Gender

☒ Male ☐ Female

1. Have you been through knee surgery and get to know the rehab exercises?

☐ Yes ☒ No

2. What do you think about these rehab exercises?

Boring — Excited

1	2	3	4	5	6	7	8	9	10

3. What do you think if there's some interactive mirror feedback while you are doing those rehab exercises?

Not interested — Interested

1	2	3	4	5	6	7	8	9	10

Feel free to go through the digital prototype video and play with the interface

4. How likely is it that you would recommend this interface to a friend or a company?

Not at all likely — Extremely likely

1	2	3	4	5	6	7	8	9	10

5. Overall, how would you rate this interface?

☒ Excellent ☐ Very good ☐ Good ☐ Fair ☐ Poor

6. How helpful do you think if patients have this interface while you doing rehab exercises?

☒ Extremely helpful ☐ Very helpful ☐ Somewhat helpful ☐ Not so helpful ☐ Not at all helpful

7. How satisfied are you with the reliability of this interface?

☒ Extremely satisied ☐ Very satisied ☐ Somewhat satisied ☐ Not so satisied ☐ Not at all satisied

8. How satisfied are you with the look and feel of this interface?

☒ Extremely satisied ☐ Very satisied ☐ Somewhat satisied ☐ Not so satisied ☐ Not at all satisied

9. How satisfied are you with the typeface readability and design of this interface?

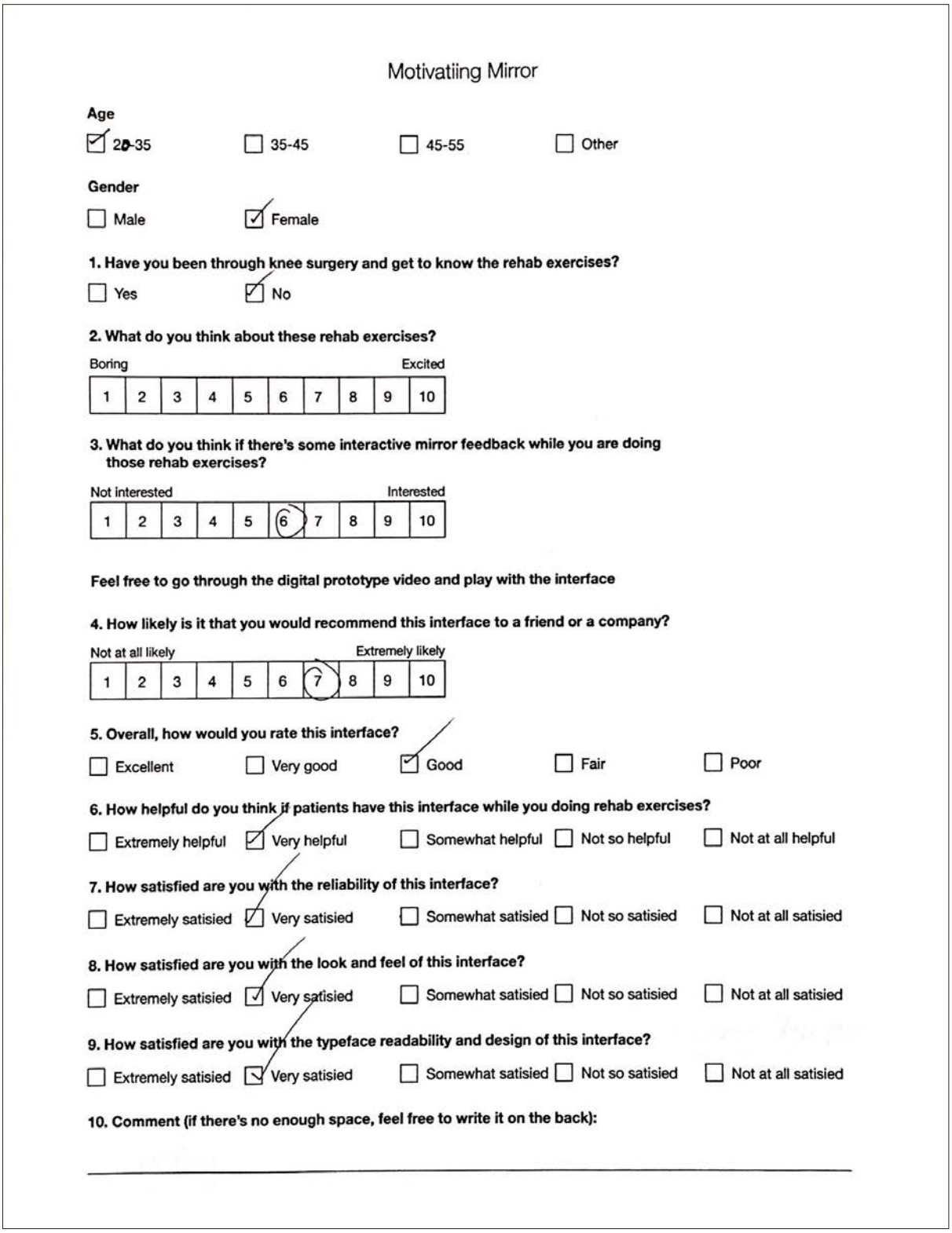
☒ Extremely satisied ☐ Very satisied ☐ Somewhat satisied ☐ Not so satisied ☐ Not at all satisied

10. Comment (if there's no enough space, feel free to write it on the back):

Keep up the good work.

APPENDIX

A: Imagine RIT Surveys



Motivatiing Mirror

Age

☑ 20-35 ☐ 35-45 ☐ 45-55 ☐ Other

Gender

☐ Male ☑ Female

1. Have you been through knee surgery and get to know the rehab exercises?

☐ Yes ☑ No

2. What do you think about these rehab exercises?

Boring — Excited

1	2	3	4	5	6	7	8	9	10

3. What do you think if there's some interactive mirror feedback while you are doing those rehab exercises?

Not interested — Interested

1	2	3	4	5	(6)	7	8	9	10

Feel free to go through the digital prototype video and play with the interface

4. How likely is it that you would recommend this interface to a friend or a company?

Not at all likely — Extremely likely

1	2	3	4	5	6	(7)	8	9	10

5. Overall, how would you rate this interface?

☐ Excellent ☐ Very good ☑ Good ☐ Fair ☐ Poor

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10. Comment (if there's no enough space, feel free to write it on the back):

APPENDIX

A: Imagine RIT Surveys

Motivatiing Mirror

Age

☑ 20-35 ☐ 35-45 ☐ 45-55 ☐ Other

Gender

☐ Male ☑ Female

1. Have you been through knee surgery and get to know the rehab exercises?

☐ Yes ☑ No

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1	2	3	4	5	6	7	8	(9)	10

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Not at all likely — Extremely likely

1	2	3	4	5	6	7	8	9	(10)

5. Overall, how would you rate this interface?

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9. How satisfied are you with the typeface readability and design of this interface?

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10. Comment (if there's no enough space, feel free to write it on the back):

APPENDIX

A: Imagine RIT Surveys

Motivatiing Mirror

Age

☑ 20-35 ☐ 35-45 ☐ 45-55 ☐ Other

Gender

☐ Male ☑ Female

1. Have you been through knee surgery and get to know the rehab exercises?

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10. Comment (if there's no enough space, feel free to write it on the back):

A: Imagine RIT Surveys

Motivatiing Mirror

Age

☒ 20-35 ☐ 35-45 ☐ 45-55 ☐ Other

Gender

☐ Male ☒ Female

1. Have you been through knee surgery and get to know the rehab exercises?

☐ Yes ☐ No

2. What do you think about these rehab exercises?

Boring — Excited

1	2	3	4	5	6	7	(8)	9	10

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Not interested — Interested

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Not at all likely — Extremely likely

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10. Comment (if there's no enough space, feel free to write it on the back):

A: Imagine RIT Surveys

Motivatiing Mirror

Age

☑ 20-35 ☐ 35-45 ☐ 45-55 ☐ Other

Gender

☐ Male ☑ Female

1. Have you been through knee surgery and get to know the rehab exercises?

☐ Yes ☑ No

2. What do you think about these rehab exercises?

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1	2	3	4	5	6	7	8	9	10
							✓		

3. What do you think if there's some interactive mirror feedback while you are doing those rehab exercises?

Not interested — Interested

1	2	3	4	5	6	7	8	9	10
									✓

Feel free to go through the digital prototype video and play with the interface

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Not at all likely — Extremely likely

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								✓	

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8. How satisfied are you with the look and feel of this interface?

☐ Extremely satisied ☑ Very satisied ☐ Somewhat satisied ☐ Not so satisied ☐ Not at all satisied

9. How satisfied are you with the typeface readability and design of this interface? Pingfang Type face.

☐ Extremely satisied ☑ Very satisied ☐ Somewhat satisied ☐ Not so satisied ☐ Not at all satisied

10. Comment (if there's no enough space, feel free to write it on the back):

Ping fang.

A: Imagine RIT Surveys

Motivatiing Mirror

Age

☒ 25-35 ☐ 35-45 ☐ 45-55 ☐ Other

Gender

☐ Male ☒ Female

1. Have you been through knee surgery and get to know the rehab exercises?

☐ Yes ☒ No

2. What do you think about these rehab exercises?

Boring — Excited

1	2	3	4	5	6	7	8	9	10

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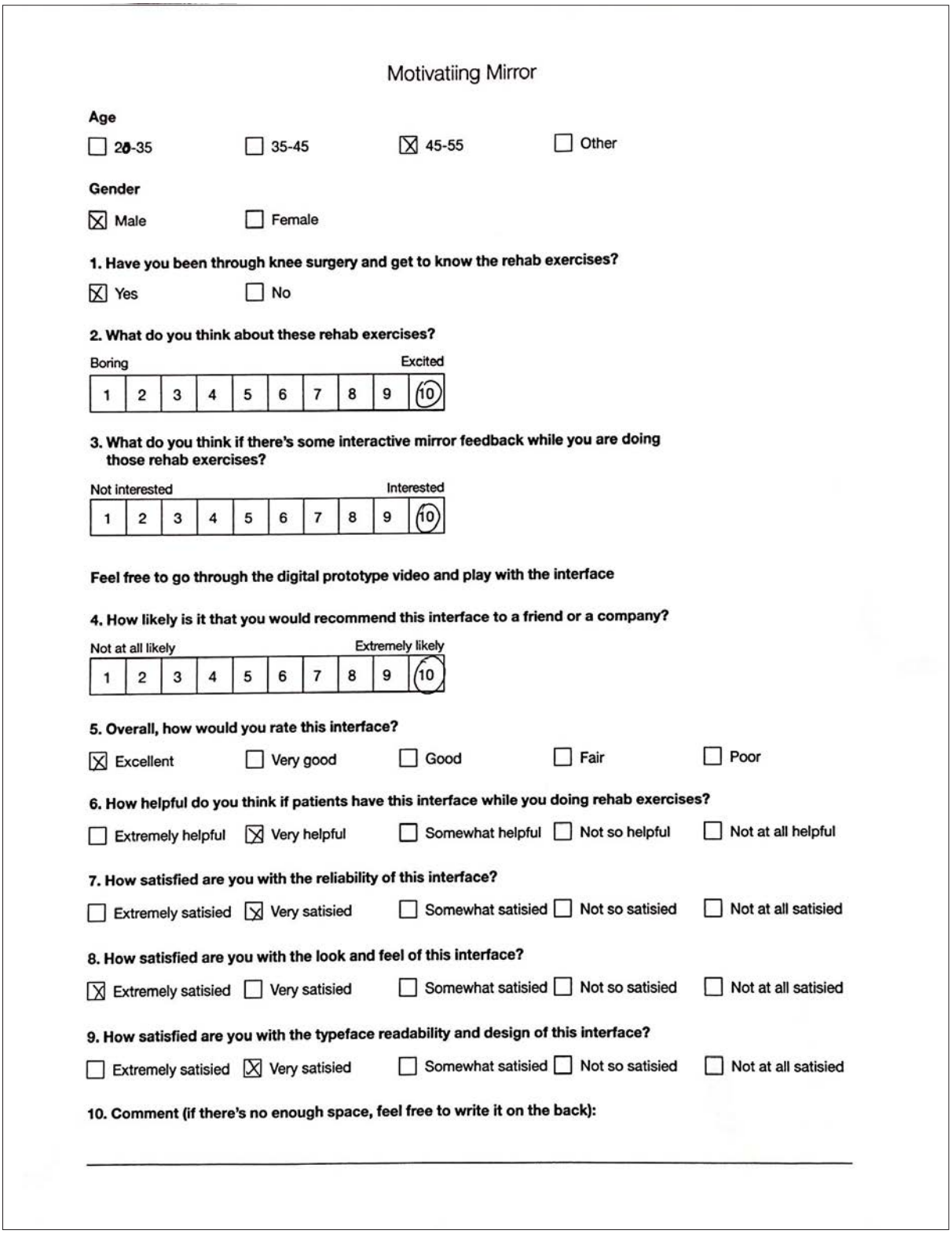
A: Imagine RIT Surveys



Motivatiing Mirror

Age

☐ 20-35 ☐ 35-45 ☒ 45-55 ☐ Other

Gender

☒ Male ☐ Female

1. Have you been through knee surgery and get to know the rehab exercises?

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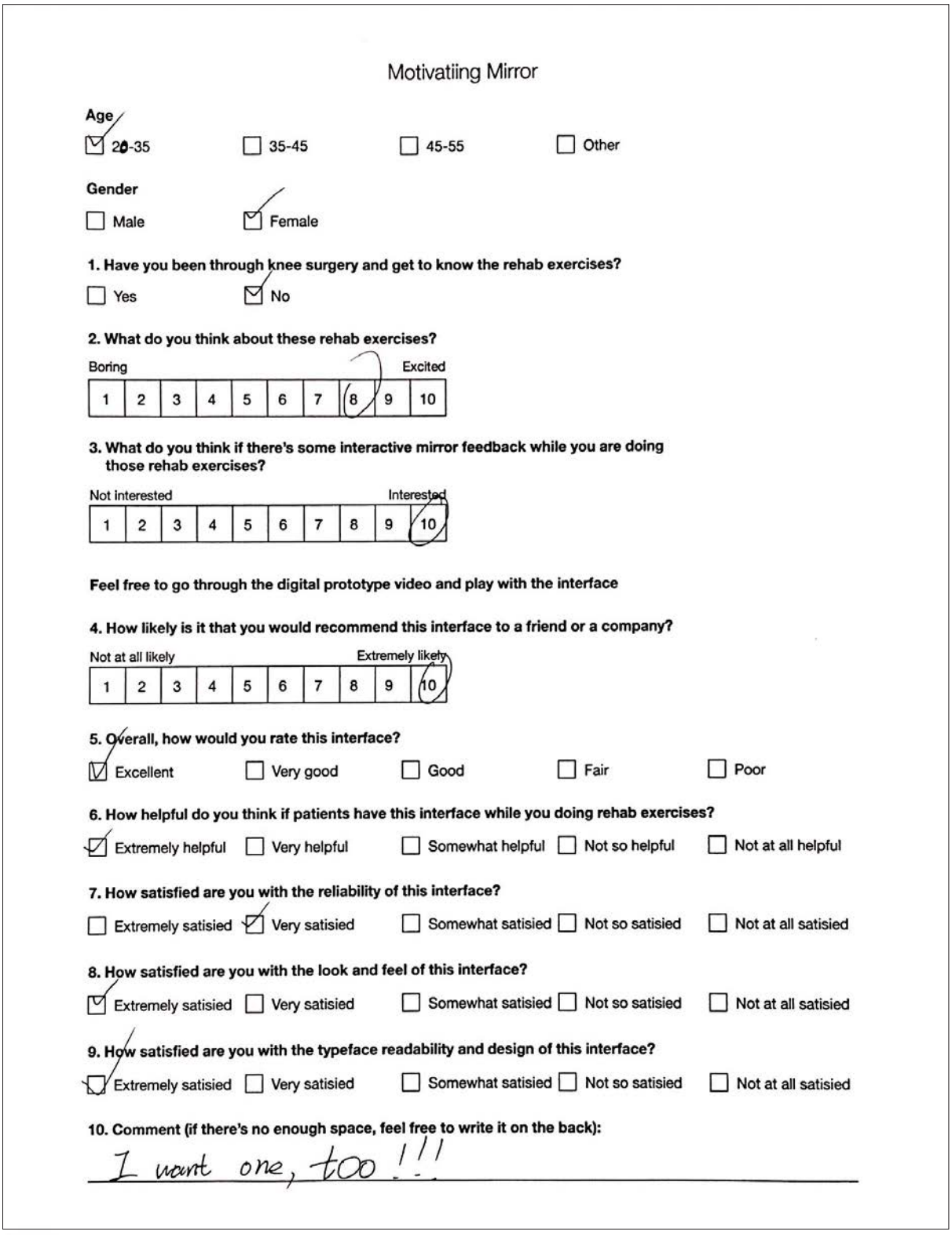

Motivatiing Mirror

Age

☑ 20-35 ☐ 35-45 ☐ 45-55 ☐ Other

Gender

☐ Male ☑ Female

1. Have you been through knee surgery and get to know the rehab exercises?

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Boring — Excited

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Not interested — Interested

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☑ Extremely helpful ☐ Very helpful ☐ Somewhat helpful ☐ Not so helpful ☐ Not at all helpful

7. How satisfied are you with the reliability of this interface?

☐ Extremely satisied ☑ Very satisied ☐ Somewhat satisied ☐ Not so satisied ☐ Not at all satisied

8. How satisfied are you with the look and feel of this interface?

☑ Extremely satisied ☐ Very satisied ☐ Somewhat satisied ☐ Not so satisied ☐ Not at all satisied

9. How satisfied are you with the typeface readability and design of this interface?

☑ Extremely satisied ☐ Very satisied ☐ Somewhat satisied ☐ Not so satisied ☐ Not at all satisied

10. Comment (if there's no enough space, feel free to write it on the back):

I want one, too!!!

A: Imagine RIT Surveys

Motivatiing Mirror

Age

☐ 20-35 ☒ 35-45 ☐ 45-55 ☐ Other

Gender

☐ Male ☒ Female

1. Have you been through knee surgery and get to know the rehab exercises?

☐ Yes ☒ No

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Boring — Excited

1	2	3	4	5	6	7	8	9	(10)

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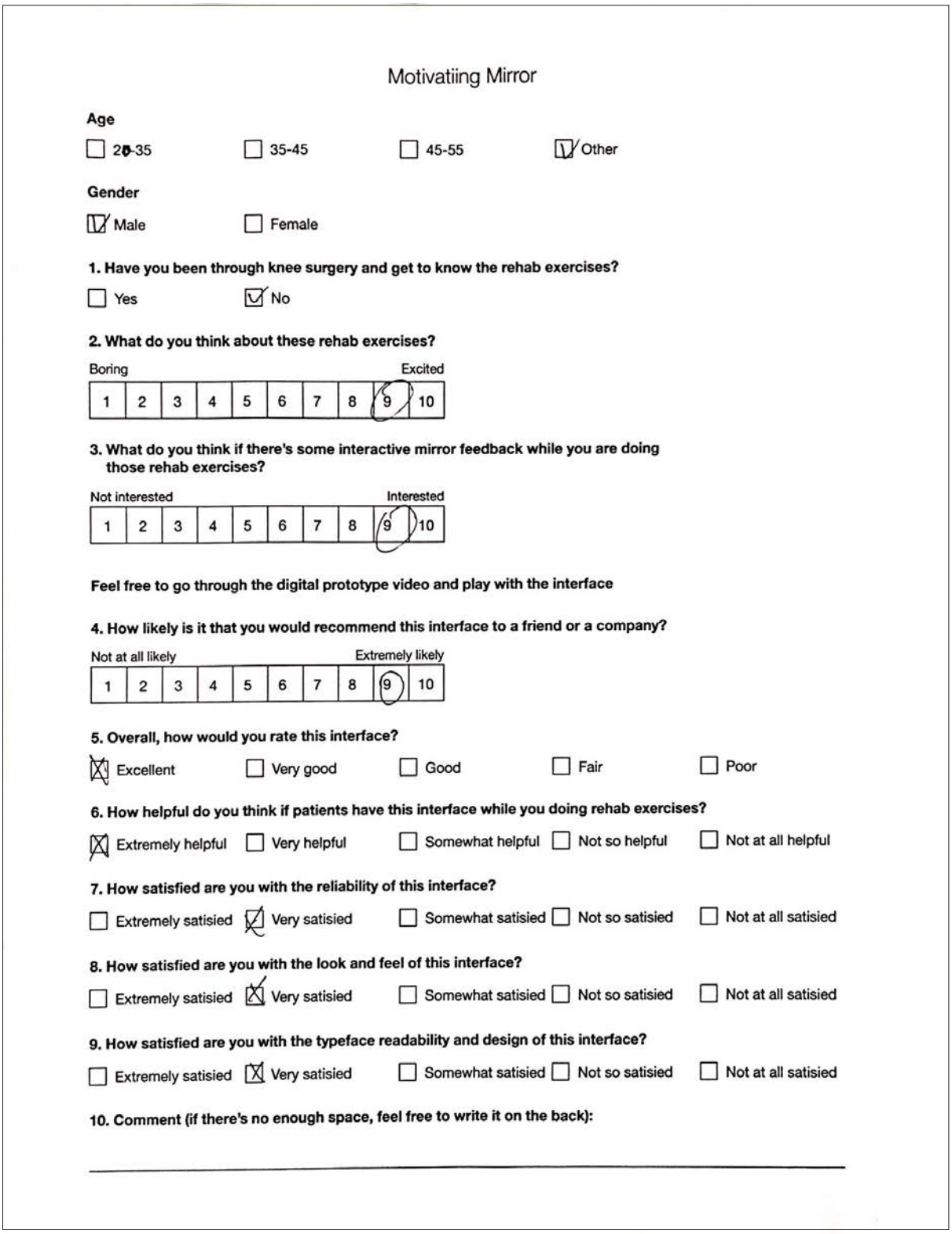

Motivatiing Mirror

Age

☐ 20-35 ☐ 35-45 ☐ 45-55 ☑ Other

Gender

☑ Male ☐ Female

1. Have you been through knee surgery and get to know the rehab exercises?

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Boring — Excited

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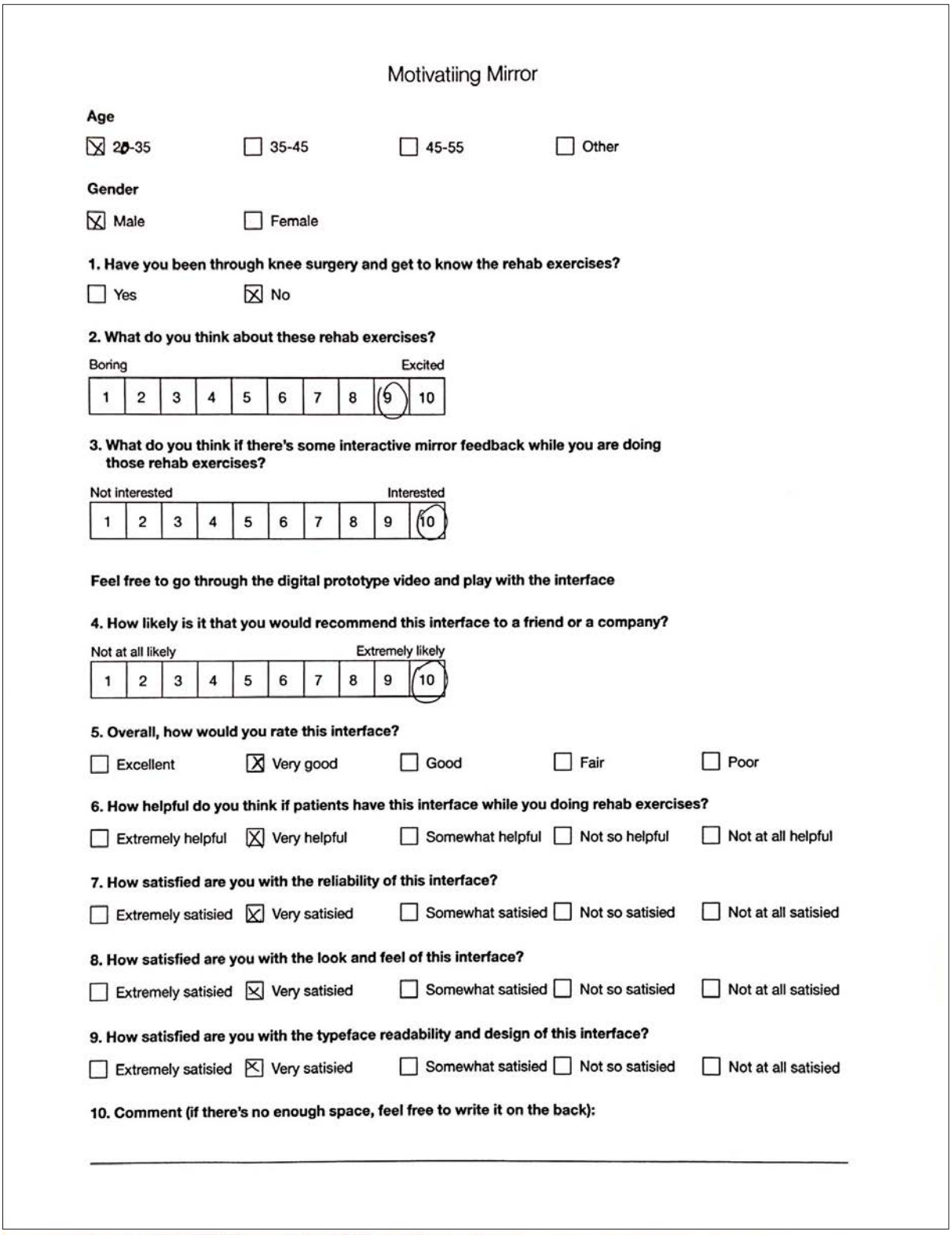

Motivatiing Mirror

Age

☒ 20-35 ☐ 35-45 ☐ 45-55 ☐ Other

Gender

☒ Male ☐ Female

1. Have you been through knee surgery and get to know the rehab exercises?

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Boring — Excited

1	2	3	4	5	6	7	8	(9)	10

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Not interested — Interested

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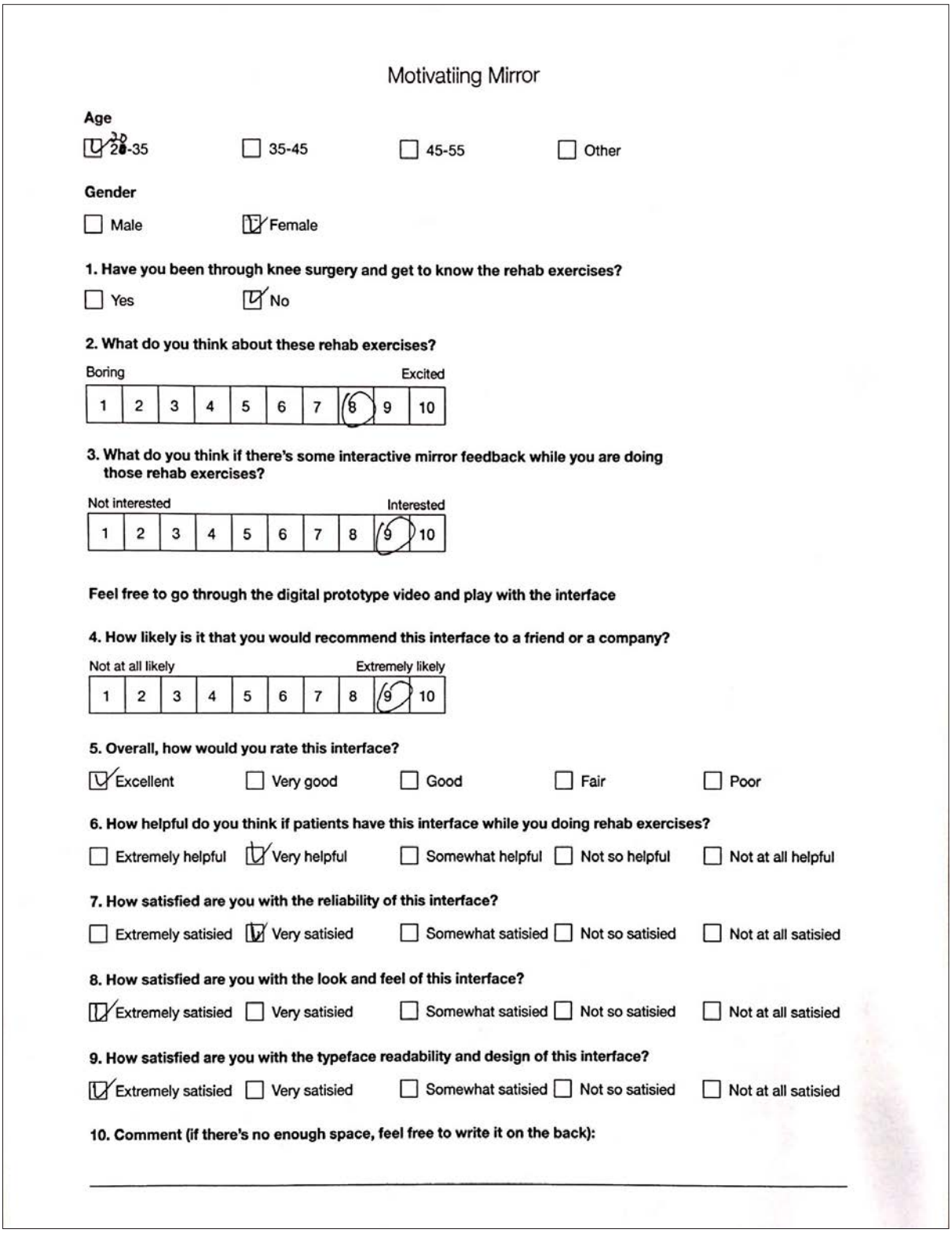

Motivatiing Mirror

Age

☑ 20-35 ☐ 35-45 ☐ 45-55 ☐ Other

Gender

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Not interested — Interested

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Not at all likely — Extremely likely

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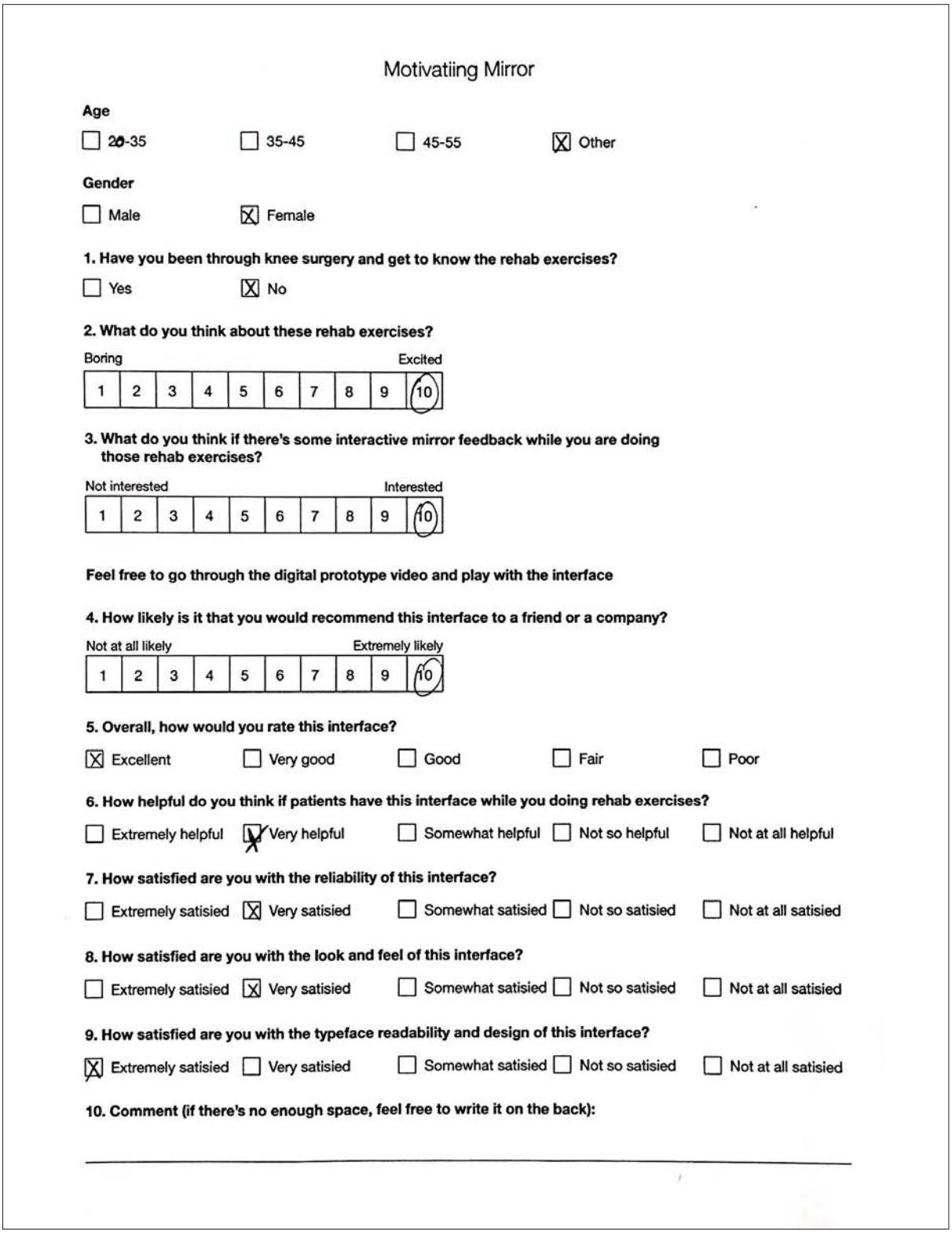

Motivatiing Mirror

Age

☐ 20-35 ☐ 35-45 ☐ 45-55 ☒ Other

Gender

☐ Male ☒ Female

1. Have you been through knee surgery and get to know the rehab exercises?

☐ Yes ☒ No

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☒ Excellent ☐ Very good ☐ Good ☐ Fair ☐ Poor

6. How helpful do you think if patients have this interface while you doing rehab exercises?

☐ Extremely helpful ☒ Very helpful ☐ Somewhat helpful ☐ Not so helpful ☐ Not at all helpful

7. How satisfied are you with the reliability of this interface?

☐ Extremely satisied ☒ Very satisied ☐ Somewhat satisied ☐ Not so satisied ☐ Not at all satisied

8. How satisfied are you with the look and feel of this interface?

☐ Extremely satisied ☒ Very satisied ☐ Somewhat satisied ☐ Not so satisied ☐ Not at all satisied

9. How satisfied are you with the typeface readability and design of this interface?

☒ Extremely satisied ☐ Very satisied ☐ Somewhat satisied ☐ Not so satisied ☐ Not at all satisied

10. Comment (if there's no enough space, feel free to write it on the back):

Providing an interactive experience to knee surgery patients to assist them with a more effective rehabilitation

Yu He

Thesis Proposal

Rochester Institute of Technology
College of Imaging Arts & Science
School of Design
MFA Visual Communication Design
Oct. 2016

Thesis Committee approval

Title

Using interaction design with motion graphics to providing an interactive experience that can possibly motivate patients who had knee surgery.

Committee Members

Chief Thesis Advisor:

Dan DeLuna, MFA Visual Communication Design

Signature of Chief Thesis Adviser | Date

Associate Thesis Advisor:

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Abstract

There are many tools for people with a knee injury to use for rehabilitation. Physical Therapists and occupational therapists work with patients on rehabilitation to help them recover, bring them back from illness or injury. For knee surgery patients, they will go through rehabilitation including CPM (Continuous passive movement) and exercises assigned by PT (Physical Therapists) to improve recovery.

The CPM is a passive motion that a machine forces patients to do, and along with and after that, patients need to be active to do other exercises themselves. Lots of patients run into trouble when rehabbing, some of them refuse to do the exercises because they have a negative attitude about this rehabilitation, some of them think it's troublesome to go to the gym do the rehab exercises, they just stay at home and wait until their leg recovers, and others are afraid of the rehabilitation. Whatever the reason, it turns out they won't recover very well.

As part of this preliminary study, a survey was presented to patients who had knee injury and doctors who are expert in knee surgery. The patients were asked if they would find it beneficial and appealing to have a more effective experience while they taking rehab exercises. The general consensus was they would find it's useful as they could be more interested in rehab instead of forcing themselves go to a hospital. On the other side, doctors weren't so sure about it because we don't have anything similar on the market. Besides, this project wasn't so fascinating since the rehab exercises are limited and repeat.

This proposal is trying to help patients spontaneously deal with their rehabilitation in a more active way, help them maintain their health level or to have the passion to explore ways to improve it, and help recover patients' both physiological and psychological health.

The purpose of this design would be that users could increase flexibility while they have walking limitations, and encourage them with more effective rehabilitation.

Problem Statement

Providing an interactive experience to knee surgery patients to assist them with a more effective rehabilitation

A better rehab experience is needed for those patients who have had knee surgery. Using interaction design to develop an user interface that can explore different function and different methods to help patients actively have a better rehabilitation.

This thesis project explores interaction, user interface and experience design for patients taking rehabilitation after knee surgery. Users will be able to spontaneous take an active part in rehabilitation. Help recover patients' both physiological and psychological health.

The concept is using Augmented Reality(AR) design an interactive display interface, this AR display device may be commonly used in several years, it might help patients have better user experience and be more active while they having rehab sports. While using this device, users may interact with the device by using visual sensor, voice order, etc.

This project will using interactive design to design a interface for this AR device, motion graphic as video prototype to help people better understanding about this project.

Though there is a device that can help doctors to see through patients' body and get detail informations of bones and muscle to operate better, there is nothing similar on the market for knee surgery patients, this project is achievable in several years and would be helpful to help patients willing to do rehabilitation.

Situation Analysis

Nowadays there are a series of rehabilitation exercises for people who suffer from knee injury[1]. It usually take 12 weeks[2] for patients to go back to normal daily life and 16 weeks to regain full muscle strength and increase overall conditioning but only if they follow the instruction from the PT and did rehabilitation well, and after 12 weeks, it's still important to continue with exercises. While patients go through the rehabilitation, they have to follow the instructions on the equipment in CPM stage, and have to follow doctors' instructions to do exercises to help with recovery, but the process that patients go through is rather boring and without passion. In addition, there are lots of patients who are suffering from both physiological and psychological trauma. Patients couldn't get a perfect recovery while they have no power and passion to take part in rehabilitation. Some of them may even be too afraid of pain they need to suffer while exercising to get rehabilitation. As a focus area, people having knee surgery will be the main component of this thesis project.

To get more information from patients, one on-line questionnaire has been published and has gotten responses from doctors and patients. The main questions include:

- What's the name of the person injured?
- What's the gender of the person injured?
- How old is the patient?
- How badly does this injury affect him/her?
- Did patient go through the whole rehabilitation?
- If yes, what's the process for the rehab? If not, why patient didn't go to rehab?
- What are the commonly used rehab exercises?
- For rehab, will it be different rehab exercises between knee replacement patients and knee surgery patients? And is there any difference between different generations and different occupations?
- If there is any interactive experience for patients to motivate him/her to do the rehab

1 "Exercises for ACL Rehabilitation." Exercises for ACL Rehabilitation | Sportsinjuryclinic.net, www.sportsinjuryclinic.net/sport-injuries/knee-pain/acl-injury/strengthening-acl-injury.

2 @Hjluks. "Physical Therapy Following an ACL Reconstruction : Expert Series #3 - Howard J. Luks, MD." Howard J. Luks, MD, 28 Oct. 2014, www.howardluksmd.com/orthopedic-social-media/physical-therapy-following-acl-reconstruction-expert-series-3/.

Situation Analysis

exercises, what kind of experiences do you think the patients might be interested in?

- If there are some entertainment activities happening while patients are exercising, will these activities diffuse patients' attention and energies, and have bad influences for the rehab? Or will it be helpful for patients to not pay attention to painful exercises?

Based on the responses this questionnaire got, the exercises for rehab are determined by how badly he/she hurts and how long since the surgery. 84.3% of respondents said physical feedback would be a great way to show the patients overall condition because it can tell them realistically how far along they have come for their recovery. This can give patients a realistic time period of how their progress is doing and how long it will roughly take for their rehab of the surgical knee or replaced knee. At the same time, 72.9% of participants said digital interaction would be optimal too because at the same time, it will represent the knee of the patient and it can show them how the overall healing process works and what the body is going through to recover his/her knee function. However, it also comes down to price and how much can the patient afford for recovery as opposed to physical feedback with PT covered by insurance or so. And 78.2% of respondents feel if there are entertainment activities, it will motivate the patients if they can be more interactive with their recovery in rehab. Usually patients are really tired or frustrated about how long the healing process typically takes. But, it is important that patients keep up with their rehab because it will help them recover following surgeries. It will be a good distracting tool to not have patients be so worried about the pain and rather focused on the exercises in a fun and engaging manner. Sometimes with our pain, we perceive a lot of pain, but at the same time, we can trick our brain with imagery and distraction to not think too much about the pain.

The goal of this thesis project is to provide a solution that people who need rehab for knee surgery may use to willingly take part in rehabilitation and will improve their rehab quality. According to the questionnaire and research, there are different kinds of knee surgeries such as Arthroscopy: Trimming a Torn Meniscus, Meniscus Repair, ACL Reconstruction,

Situation Analysis

Microfracture, etc. For rehab, patients would do a lot of range of motion exercises to get the knee muscles working again and to slowly progress on the movement of the knees to walking around, extension, flexing, and going from a passive range of motion to an active range of motion. This project is focused on adults who are younger than 60 years old because the older generation might need knee replacement which is a different section from knee surgery.

By using AR devices and having interesting interactive way with patients such as clearly showing muscle rebuilding, adding achievement to exercises, patients will be more interested in rehab and improve recovery. A variety of interactive tools will be used to help develop a comprehensive design for users.

There is a need for a design like this since there is nothing else similar for patients on the market. There are traditional devices for people who had knee surgery that do not use digital interaction. There is AR for doctors to help with surgery, but not for rehab. Most of the patients are not paying attention to get effective rehabilitation. The majority don't take rehab as their first choice because they need to go to a specific place to exercise and the process has no passion, instead they just leave the hurt knee alone.

This product will contribute to both fields of design and health. Through user interaction, user experience, motion graphics, interactivity and augmented reality, patients can have a good experience while rehabbing. Motion graphics will be used to help with fine motor skills and augmented reality will be used for study of human movement. Since this project is focus on the interface part, motion graphics will also help with the interface design.

Survey of Literature

Books

Don't Make Me Think: A Common Sense Approach to Web Usability, 3rd Edition. Steve Krug San Francisco, CA, Peach Pit, 2014.

This book discusses web usability and how designers need to be aware of what their audience wants and needs. Krug focuses on how designers need to keep in mind what they are designing and how they are implementing the content, and how to make it the most effective for their audience.

The Design of Everyday Things. Don Norman. New York, New York: Basic Books, 2013.

Don Norman discusses the concept of usability in design. Bad design is prevalent and the need for thoughtful design with the user in mind is a necessity. Norman points out why some designs are successful and how the designs and the design decisions affect their users.

Garrett, Jesse James. The Elements of User Experience: User-centered Design for the Web and beyond. Berkeley, CA: New Riders, 2011.

This book lists author's understanding and summary about elements of the user experience. He have five Plane for user experience: 1) The surface plane 2) The skeleton plane 3) The structure plane define the placement of pages, using process and navigational elements 4) The scope plane 5) The strategy plane. The author's purpose appear to be explain user experience in his own eyes and give us a simplify understanding with user experience. This book is more focus on basic understanding than others and can give us a clearer view about user experience. It's really useful as a guide to introduce user experience.

Helen Sharp. Yvonne Rogers. Jenny Preece. Interaction Design: Beyond Human-Computer Interaction; Second Edition. John Wiley & Sons, 2007.

This book is talking about how to design a product and help people to interactive with it. This is a classic book about interaction design. It has the basic interaction design knowledge we need to use and helpful with our research and design.

Norman, Donald A. Emotional Design: Why We Love (or Hate) Everyday Things. New York: Basic Books, 2004.

In this book the author explains the importance of emotion in design based on three different dimensions: visceral, behavioral level, reflective level. Emotion in many cases has great impact of

Survey of Literature

Books

our decisions. This book gives us a different perspective to learn how to make better interaction design, The author came up with examples and science understanding about exploration.

Rubin, Jeffrey, and Dana Chisnell. Handbook of Usability Testing: How to Plan, Design, and Conduct Effective Tests, 2008.

This is a book that UX people must read. It helps people get an step by step idea about how to test the usability for your product. This book provides an knowledge about what kind of products are users want to have. This book helps designers to consider limit usability and decide when will they need to do user test.

Lotke, Paul A and Jess H. Lonner. Master Techniques in Orthopaedic Surgery Knee Arthroplasty. Philadelphia: Lippincott Williams & Wilkins, 2008.

This book described complicated problems encountered in knees surgery, wrote by the authority of the field of reconstruction of the knee. Readers can learn from their own and others' experience to improve their technology. This book focus on technique that experts prefer to use, and want readers to know that mastering knees surgery and managing not only requires a deep understanding of the scientific basis of the surgery, but also the ability to know the clinical decision and surgical subtle discrimination.

Teller, Peter. MRI Atlas of Orthopedics and Traumatology of the Knee. Berlin: Springer, 2003.

This book covers all the important diseases and injuries of the knee joints, for each part of the joint it has a comprehensive description from the normal image to the disease. Clinical evaluation of imaging is based on detailed diagnosis, disease stage and treatment results from each case data.

Articles & Websites

Goodwin PC, Morrissey MC, Omar RZ, et al. . Effectiveness of supervised physical therapy in the early period after arthroscopic partial meniscectomy, Phys Ther , 2003, vol. 83

This article disscussed will physical therapy helpful for patients after arthroscopic partial meniscectomy. The author did an test with patients who were supervised physical therapy and patients who with a home program to evaluate the effectiveness.

Grant JA, Mohtadi NG. Two- to 4-year follow-up to a comparison of home versus physical therapy-supervised rehabilitation programs after anterior cruciate ligament reconstruction, Am J Sports Med , 2010, vol. 38

Survey of Literature

Articles & Websites

https://doi.org/10.1177/0363546509359763

This article is about comparing a home based rehabilitation with a standard physical therapy program. It is a long run analysis about the difference between a patient who did home based rehab and patient who did a clinically supervised rehab.

Berth A, Urbach D, Awiszus F. Improvement of voluntary quadriceps muscle activation after total knee arthroplasty. Arch Phys Med Rehabil.

This article claimed the rehab exercises after knee surgery need to focus on improve voluntary activation. And physical therapy should make sure to increase the muscle strength.

Keays SL, Bullock-Saxton JE, Keays AC, et al. A 6-year follow-up of the effect of graft site on strength, stability, range of motion, functional and joint degeneration after anterior cruciate ligament reconstruction. Am J Sports Med. 2007.

This article is a long term study about does the material patients used matter for patients' recover. And for a reliable result, this study keep tracked some case in 6 years.

Linden M, Ejerhed L, Sernert N, et al. Patellar tendon or semitendinosus tendon aurografts for anterior cruciate ligament reconstruction. Am J Sports Med. 2007.

This article is about a study about does semitendinosus tendon graft help patients recover. For a better result, there was a two years case study and finally get a reliable data.

Risberg MA, Holm I, Myklebust G, Engebretsen L. Neuromuscular training versus strength training during first 6 months after anterior cruciate ligament reconstruction. Phys Ther. 2007.

This article wanted to determine the difference of different training for knee surgery patients. And found out there are some certain training are good for patients. This article suggested that patients need more effective training.

Shelbourne KD, Nitz P. Accelerated rehabilitation after anterior cruciate ligament reconstruction. Am J Sports Med. 1990.

This article is trying to find a different way to help patients who had ACL reconstruction. In this test, they asked patients immediate have weight bearing one day after surgery, then they had a long term follow up and get information.

Survey of Literature

Articles & Websites

Shelbourne KD, Urch SE. Primary anterior cruciate ligament reconstruction using the contralateral autogenous patellar tendon. Am J Sports Med. 2000.

This article studied the effect of two different autogenous patellar tendon graft for patients' recover speed, and this is a follow up study.

Noyes FR, Mooar LA, Barber SD. The assessment of work-related activities and limitations in knee disorders. Am J Sports Med. 1991.

This article performed a prospective randomized clinical trial in which two different occupational rating systems were tested on 50 patients.

Biggs A, Jenkins WL, Urch SE, Shelbourne KD. Rehabilitation for patients following ACL reconstruction: a knee symmetry model. N Am J Sports Phys Ther. 2009.

This article described a new model for ACL rehabilitation, the Knee Symmetry Model. This article introduced this model and how this model been used. Then described details involved in the development and implementation of this rehabilitation program. And they have some data analysis for this model to clear this model is helpful for ACL rehab.

Hohmann E, Tetsworth K, Bryant A. Physiotherapy-guided versus home-based, unsupervised rehabilitation in isolated anterior cruciate injuries following surgical reconstruction, Knee Surg Sports Traumatol Arthrosc , 2011.
https://doi.org/10.1007/s00167-010-1386-8

This study is about study the difference between patients who get standard rehabilitation program and patients who had home based rehab program. To get accurate data, 40 patients was participate in this study, they were randomly put in two rehab programs.

AAOS - OrthoInfo: Treatments & Surgeries. N.p., n.d. Web.
http://orthoinfo.aaos.org/menus/treatment.cfm#surgical_tx.

American Academy of Orthopaedic Surgeons. [Accessed May 19, 2010.];Surgical Treatments.
This is a website focuses on body's musculoskeletal system injuries, they get lots of reliable information including videos and articles about the rehabilitation.

Survey of Literature

Articles & Websites

王, 悦. “医疗技术革新风暴：AR黑科技首次助力癌症精准手术【格隆汇】.” 医疗技术革新风暴：AR黑科技首次助力癌症精准手术【格隆汇】. **N.p., 20 July 2016. Web. 10 Oct. 2016. http://www.gelonghui.com/p/75705.html**

This website is talking about AR help doctor with surgery at the first time.

“10种重新定义人机交互的交互方式（多视频）.” **36æ°ª. N.p., 13 May 2013. Web. 04 Sept. 2016. http://36kr.com/p/203663.html**

This website is about 10 interactive ways to redefine human-computer interaction.

“人机交互方式将走向何方？.” 人机交互方式将走向何方? **13 May 2015. Web. 10 Oct. 2016. http://tech.163.com/15/0513/08/APFVJ67N000948V8.html**

A study of future computer interaction and talk about the deficiencies in the use of computer interaction and top three direction for computer interaction.

龚, 莉. “Pokémon Go风靡全球 AR或将引发医疗应用革命.” Pokémon Go风靡全球 AR或将引发医疗应用革命_健康界. **CN-healthcare.com, 07 Aug. 2016. Web. 10 Oct. 2016. http://www.cn-healthcare.com/article/20160807/content-484783.html**

An article about how AR will influence medical treatment and shared some medical cases that used AR technique.

医联. “里约闭幕式中的AR技术可以颠覆医疗新认知.” 里约闭幕式中的AR技术可以颠覆医疗新认知**. Yigoonet.com, 23 Aug. 2016. Web. 10 Oct. 2016. http://m.yigoonet.com/index.php?&a=show&-catid=224&typeid=&id=32220**

AR technique in Rio 2016 Summer Olympics and currently the application of AR technology in medical field.

全球VR精选. “除了QQ-AR火炬传递，AR还有更多医疗应用案例.” 除了QQ-AR火炬传递，AR还有更多医疗应用案例. VR资讯-VR指南|YOTOVR官网, **Aug. 2016. Web. 10 Oct. 2016. http://www.yotovr.com/six-augmented-reality-healthcare-companies-shaping-future/**

This website have six cases in medical treatment field that including AR technique.

Survey of Literature

Videos

MindovermatterSC. "Knee Exercises - Strengthening Exercise after Knee Surgery 1/8." YouTube. YouTube, 07 Feb. 2012. Web. 17 Oct. 2016. https://www.youtube.com/watch?v=N1si4chpz7E

This video is about a series of knee rehab exercises. And talk about not only strengthening exercises is important, but the perfect movement for the exercises.

Garcia, Djair. "Knee Rehab after ACL Surgery with Coach Djair Garcia." YouTube. YouTube, 14 Mar. 2015. Web. 14 Oct. 2016. https://www.youtube.com/watch?v=Cc-_w6Hjym0

Some types of exercises for knee rehabilitation after ACL surgery as soon as the Stitches are removed.

NIHSeniorHealth. "Physical Therapy Exercises After Knee Replacement." YouTube. YouTube, 01 July 2014. Web. 04 Oct. 2016. https://www.youtube.com/watch?v=yhvgR3TQQr8

A physical therapist helps a woman through various exercises following her knee replacement surgery. Six exercises are shown and described.

PhysioFitnessAust. "ACL Reconstruction: Rehab Program Essentials Seminar | Feat. Tim Keeley | FILEX." YouTube. YouTube, 21 Aug. 2011. Web. 04 Oct. 2016. https://www.youtube.com/watch?v=Yp4eYFald-g

This video described what is the most important thing for patients from one patient's opinion. And showing what's the best way to have better outcome.

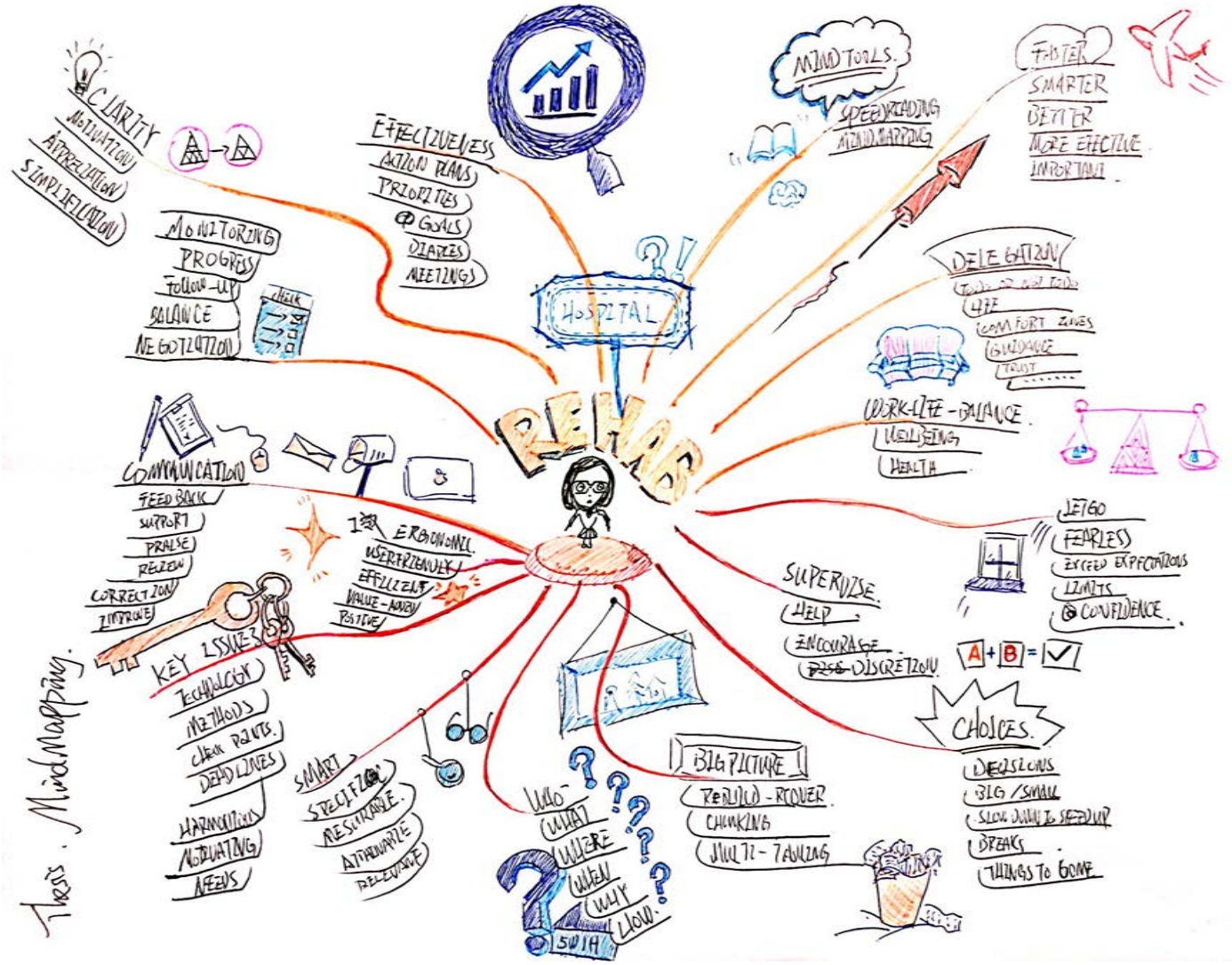
Matthew Boes M.D. "Best ACL Exercises | How to Recover From ACL Reconstruction Surgery | Phase 2." YouTube. YouTube, 28 July 2016. Web. 04 Dec. 2016. https://www.youtube.com/watch?v=QzVdEyyliu4

This video is designed to help maximize your recovery following ACL reconstruction surgery. The goals of Phase 2 program for ACL reconstruction rehabilitation are to improve range of motion to normal and restore normal gait pattern. This phase should be conducted within 2-4 weeks following surgery.

Design Ideation

Mind Mapping

For patients who had knee surgery, they will need to go through CPM and be advised to have a series of exercises that PT recommended. The intention for these exercises is helping patients recover better, but based on data analysis from the on-line questionnaire, many patients actually didn't go to hospitals to do the rehabilitation; they just rest at home and wait for their leg to recover. The goal of this proposal is to have a more passionate, comfortable, powerful, effective, compelling and motivated experience. Since the CPM process is passive with movement motivated by the machine, this project will focus on the exercises after CPM.



Design Ideation

Here is mind mapping for this project, for rehabilitation for knee surgery patients.

Mind tools. For this thesis mind tools include reading documentation and analysis data, mind mapping.

Needs. This project intends to have a faster, smarter, better, more effective and important interactive experience. For interaction design, this project needs to consider users' life style, comfort zones, work-life balance, encouraging users break the limits, and gaining users' confidence.

Choices. This project will study who is the user, what designers need to do, where this design will be used, why and when it will be used, and how to achieve it. The tentative choice is using technology which will be commonly used in few years like AR and may achieve better user experiences and have more effective rehabilitation.

Key issues. The key issues for this project will be technology problems for AR, the methods this interaction design will use, having checkpoints during the process, user' needs and the deadline for this project.

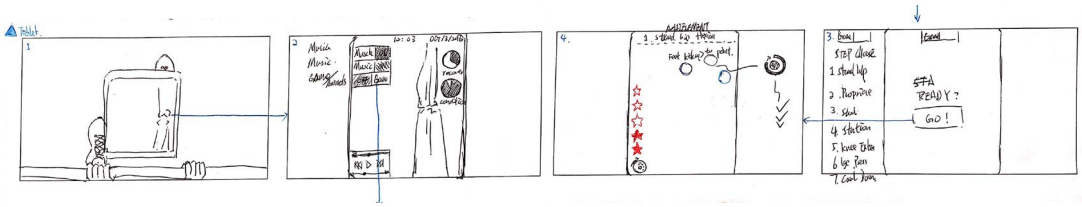
Communication. Considering consumer demand, this design attaches great importance to feedback and support from users, user's praise, correction and reviews, improving interaction design iteratively.

Design Ideation

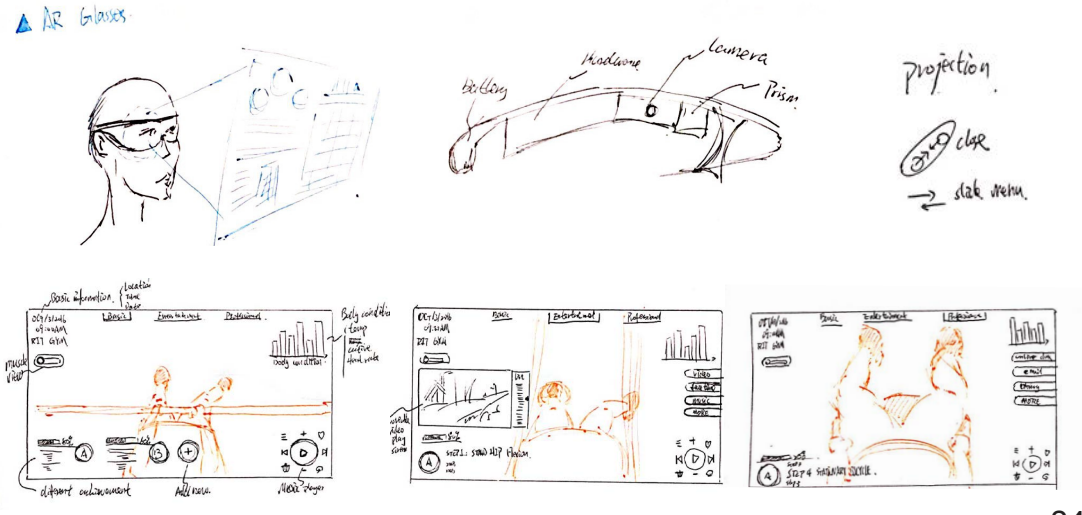
Brainstorming

First we have lots of product problem backlog, for this case is about patients who don't want to go to rehab and can not get effective recover for knees injury. Then there is the users' requirements, that is process we use to encourage patients go through effective rehabilitation. Based on those requirements, come up some implement and develop ideas.

According to the concept, using AR interactive display to attract patients, help patients willing to do rehab exercises, that led to a study about what kind of format for this AR device will be used. We need to find a form that patients can easily interactive with but no need to use lots of hands control since their hands will be busy in the rehab exercises.



AR application on phone and tablet was my very first thought. It's easy to achieve cause electronic products are commonly used nowadays and have AR for application will be much more interesting only have image on the screen. But as more and more research was done, this solution was rejected. Patients needed to use their hands to help support their body while they exercises, they won't keep their hands on the electronic devices for long time.



Design Ideation

The second thought was AR glasses that already show up on the market. And there is an AR glass for doctors to help them see through patients' muscle and see skeleton clearly so they can operate better. Therefore it would be nice if we have an AR glass for patients to help them understand how their muscle rebuild and tell them if they're doing right exercises or not. And patients even no need to go to the rehab center or gym to do the exercises. However, even we have AR glasses for doctor, it's still not widely used, AR glasses are too expensive for now, not mention as home used devices only for temporary when patients need to do rehab exercises. It would be a bad deal for patients.

These unsuccessful ideas led us to make a summing up of the experience and lessons. This design requirements for this AR device are easy to operation, fun, motivating, show exact information, at a reasonable cost. So the final idea is have an AR mirror in front of patients when they exercising in the rehab center. They can have their basic body condition in that mirror, and have an character shows how exactly they should do in specific movement. This device could use technique doctors used for physical feedback to help patients know how their knees recover. And we can have different mode for help divert patients' attention form pain. Like music section has beats along with patients' movement to motivate them do better in motion. Another section is game, patients could have various objects they can interactive with, so they can achieve specific angle the PT demand.

Design Ideation

Personas

Name: Mary

Gender: Female

Age: 37

Location: Los Angeles, CA

Occupation: Receptionist

Income: $38K

Mary is a receptionist who works really hard. She got injury of meniscus of knee joint by accident. After knee surgery, she has thought about doing rehab exercises on time, but she didn't have time for it because she wants to go to work as soon as possible. Besides, she has a strange thought that she can exercises while she walk to office. Turns out she didn't recover perfectly, her knee feels pain occasionally. She sometimes regrets about didn't doing rehab exercises. The painful knee really affect her daily life.

When Mary heard about this project, she was really interested in it. Since she likes fitness at ordinary times. If there is an interactive device that can help her rehab and can combine with gym exercises, she would love to go through rehab exercises. And it doesn't cost much to use that rehab device. She will be happy if she didn't cost much but get fine rehabilitation.

Design Ideation

Personas

Name: Joseph

Gender: Male

Age: 25

Location: New York, NY

Occupation: Student

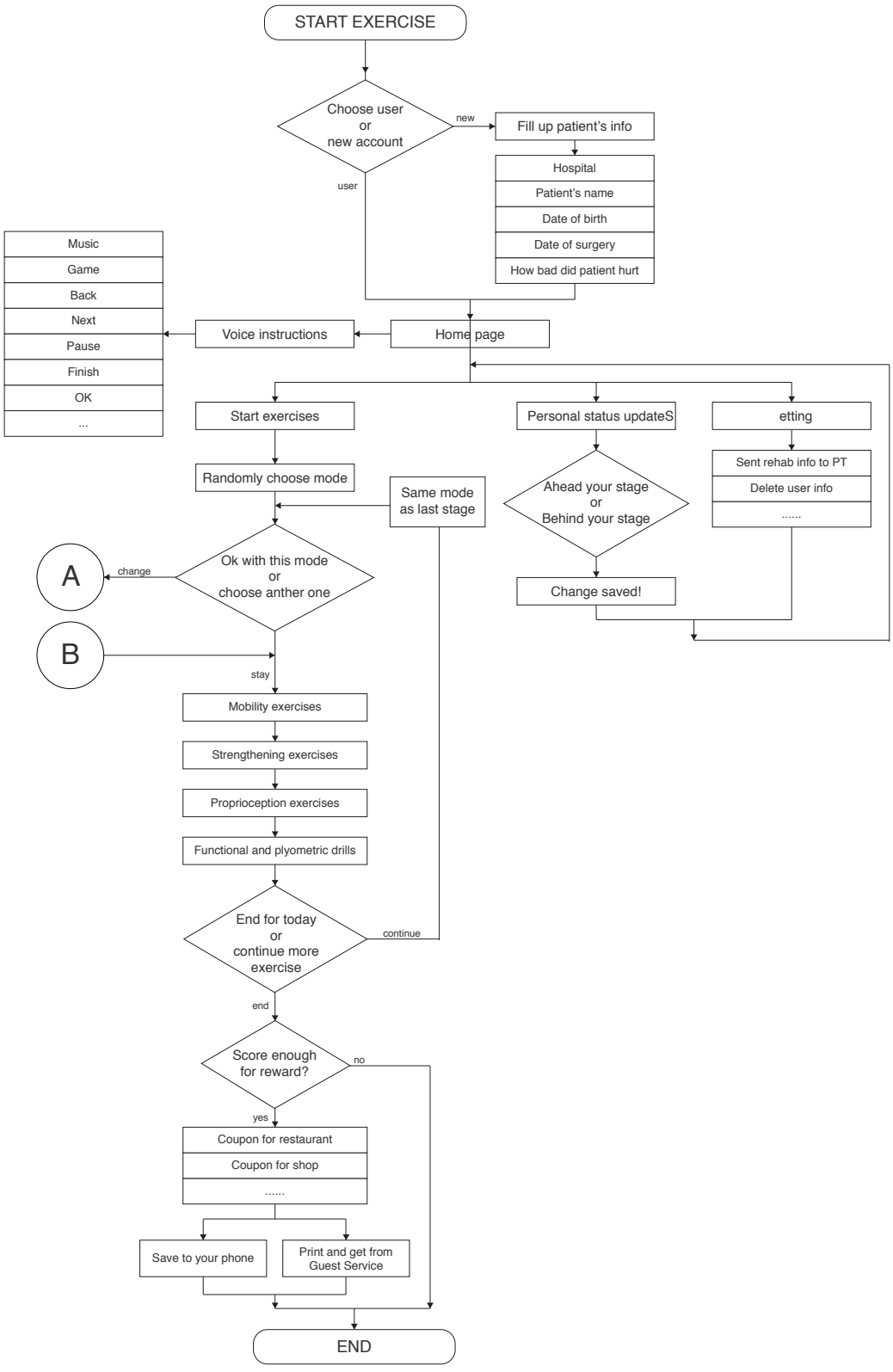
Income: Part-time job, $13.5/hr

Joseph is a graduate student, outdoor sports are on his agenda. He had an operation for rupture of knee medial collateral ligament because of one injury from outdoor sports. He was asked to go rehab center do exercises that PT asked him to do, at first he didn't want to, but his parents force him to rehab. So he did all exercises that PT required. During the exercises, he got too boring to concentrate on those exercises. And since he need to do those movement as PT required, he need to keep his eyes on the injured knee all the time. It's make him really uncomfortable when he has no pleasure on the rehab process.

He really like the idea about this project cause it's much more interesting than the old exercises.

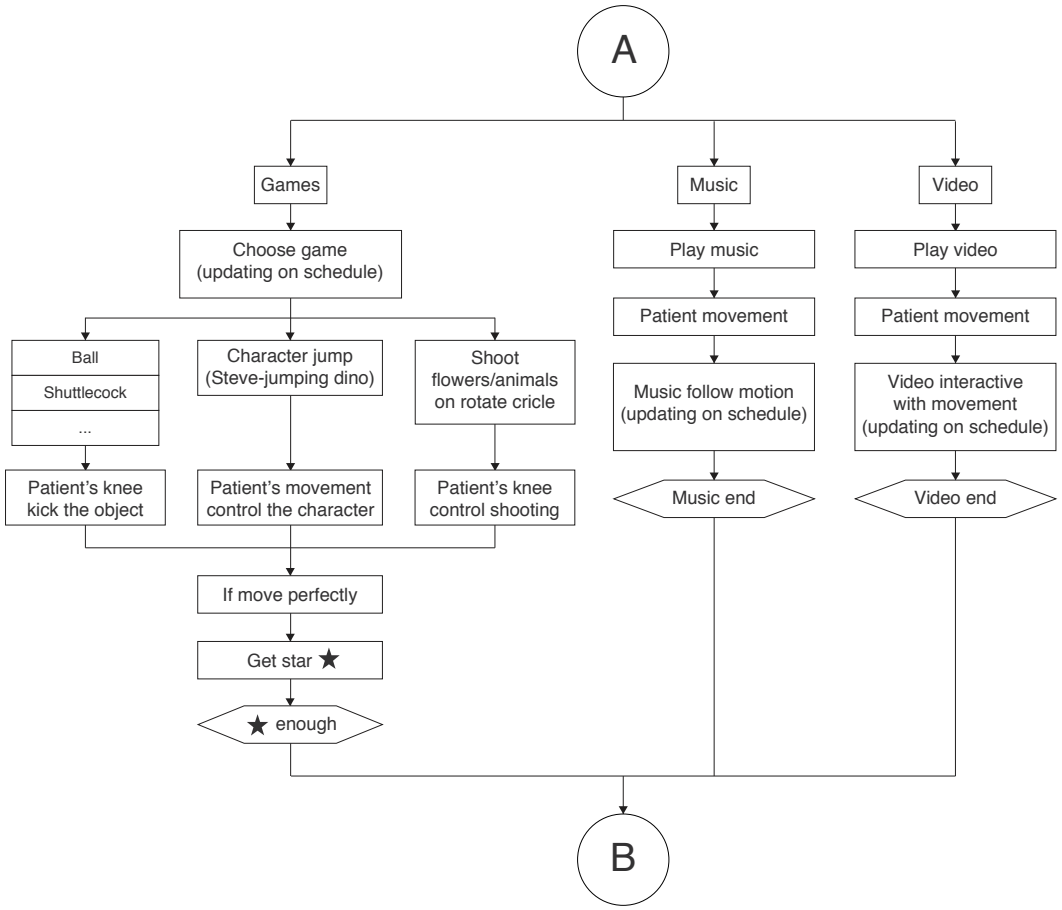
Design Ideation

Flowchart



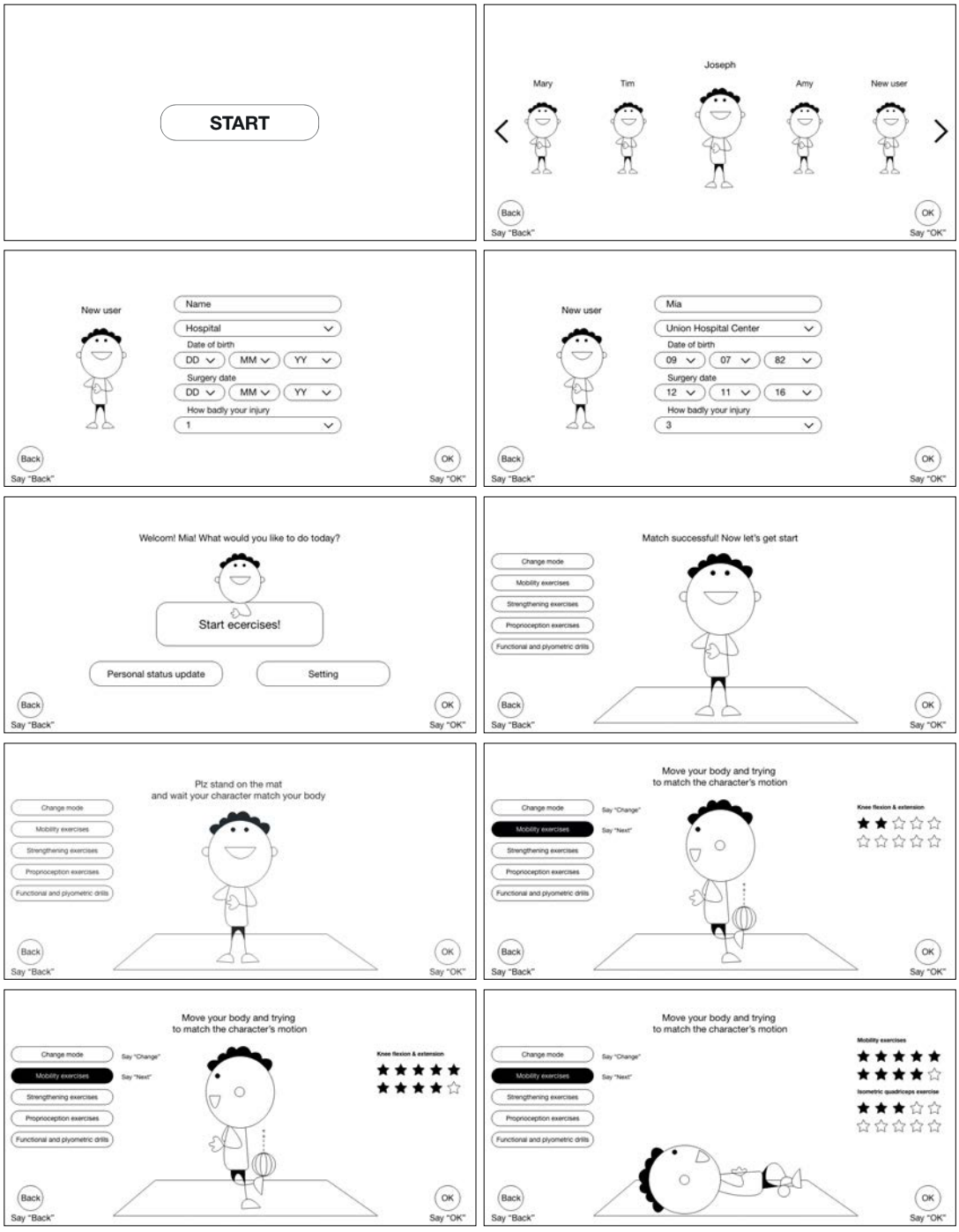
Design Ideation

Flowchart



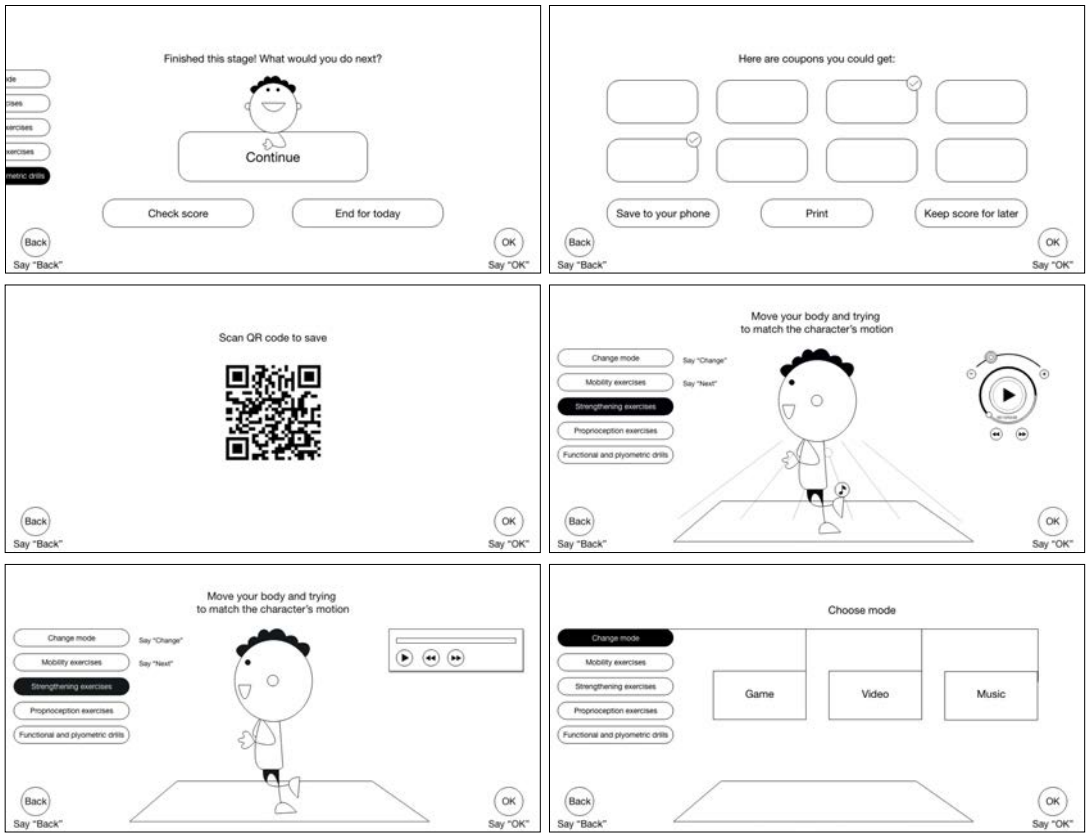
Design Ideation

Wireframe



Design Ideation

Wireframe

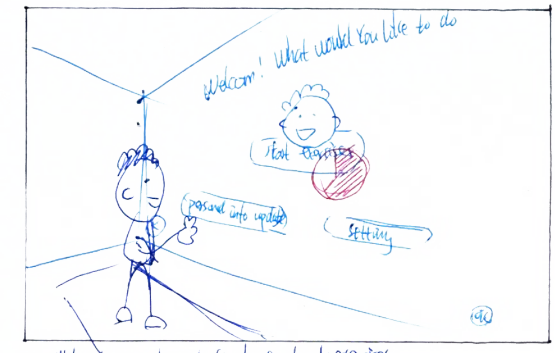


Design Ideation

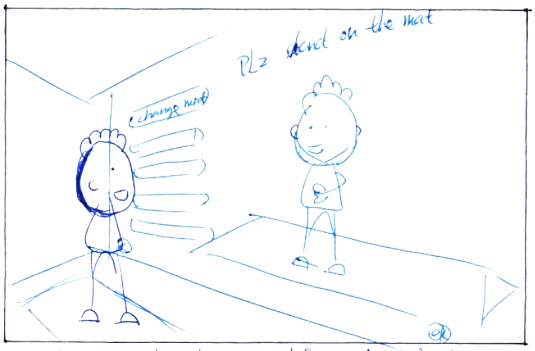
Storyboard

Design Ideation

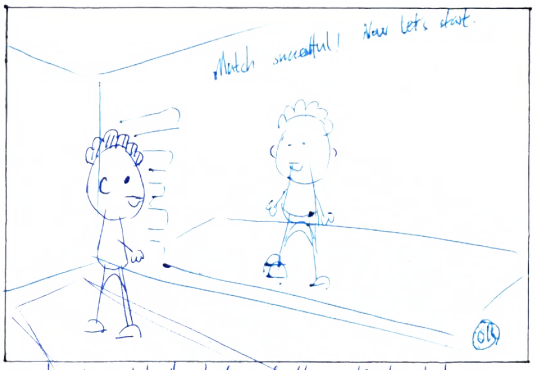
Storyboard



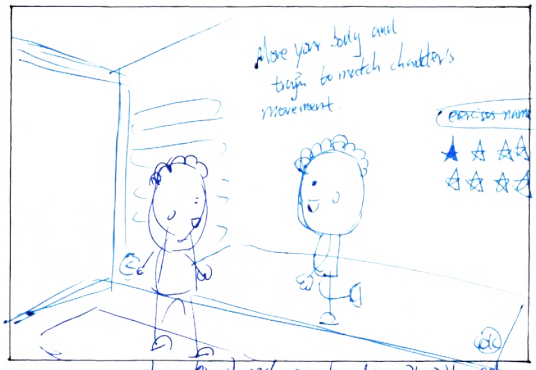
7. Welcome page showed & chose start exercises



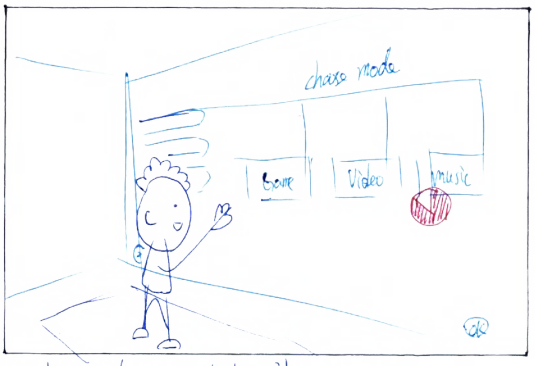
8. Show instructions for movement & Randomly ~~~ pick one mode for exercises. First detect patient's body.



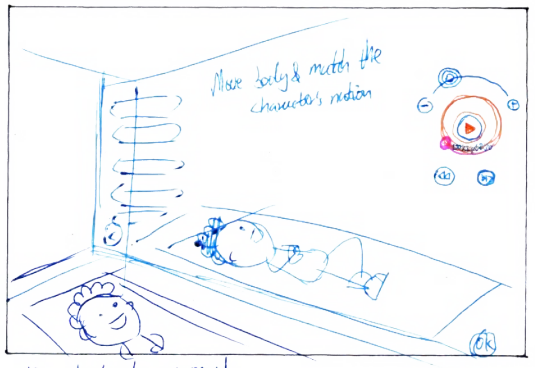
9. character match the body perfectly waitin for start.



10. move as character showed & if doing it right, get a star.
Randomly choosed mode. ~~~



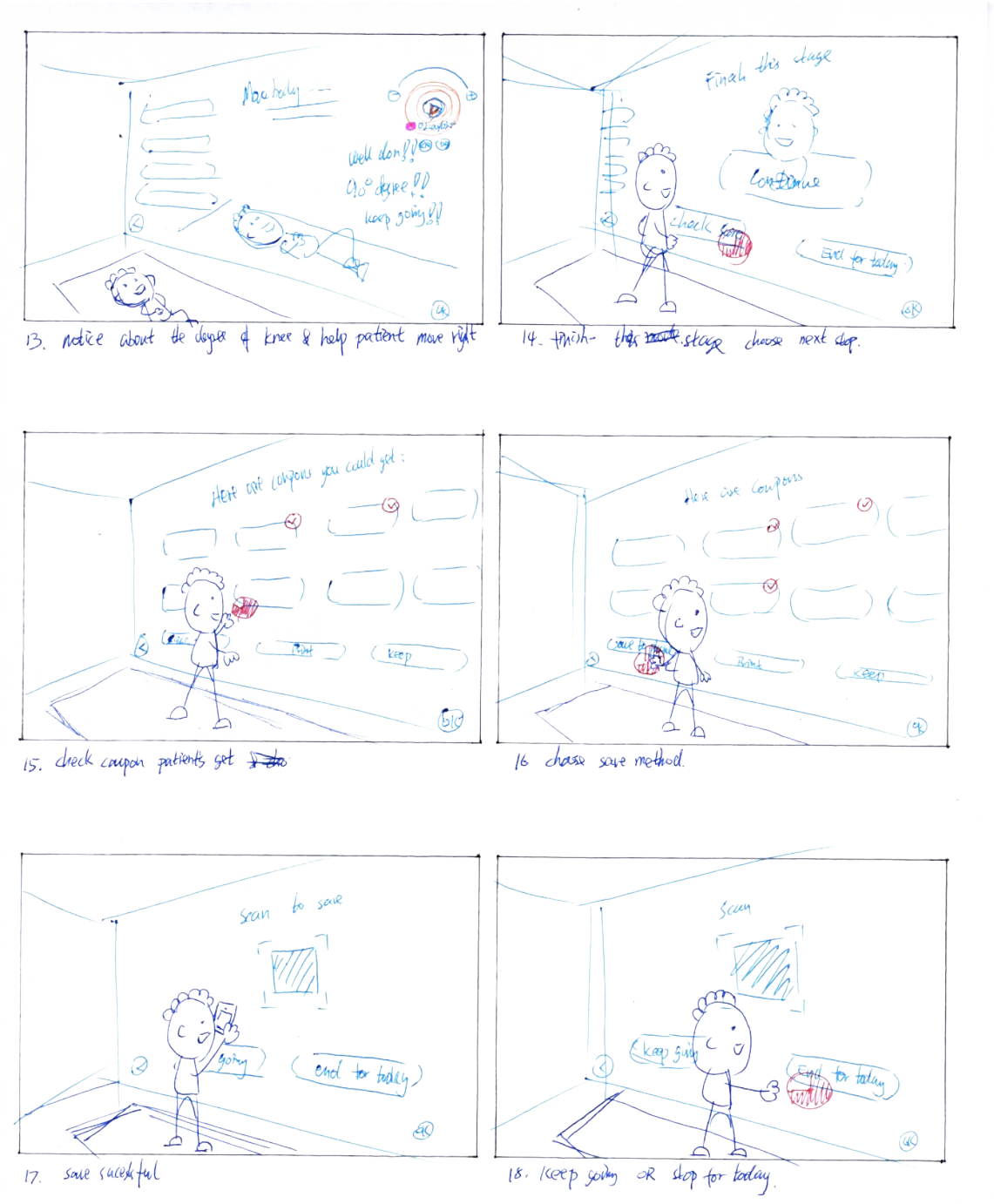
11. change mode as patient's wish



12. back to movement

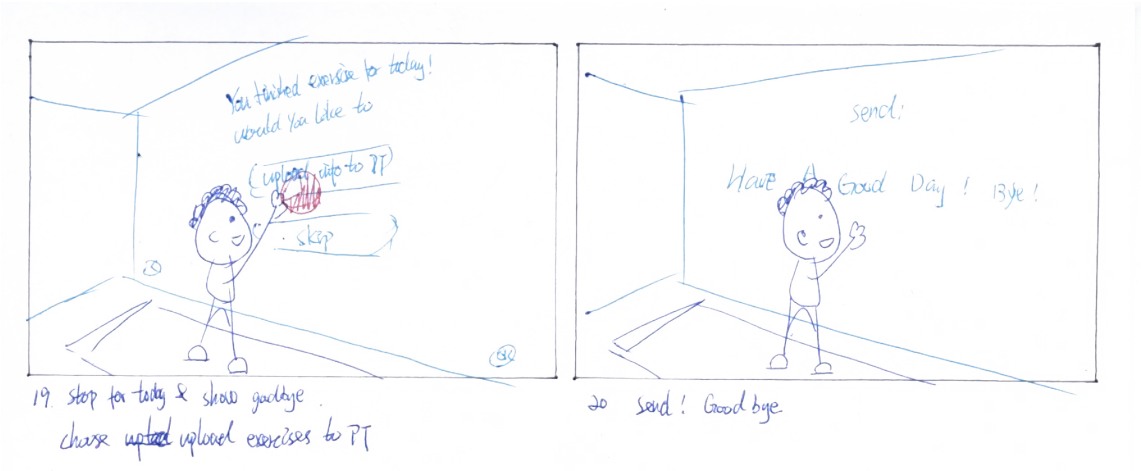
Design Ideation

Storyboard



Design Ideation

Storyboard



19. stop for today & show goodbye
choose ~~upload~~ upload exercises to PT

20 send ! Good bye

Design Ideation

Type studies

Helvetica Neue

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890 ($&.,!?)

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890 ($&.,!?)

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890 ($&.,!?)

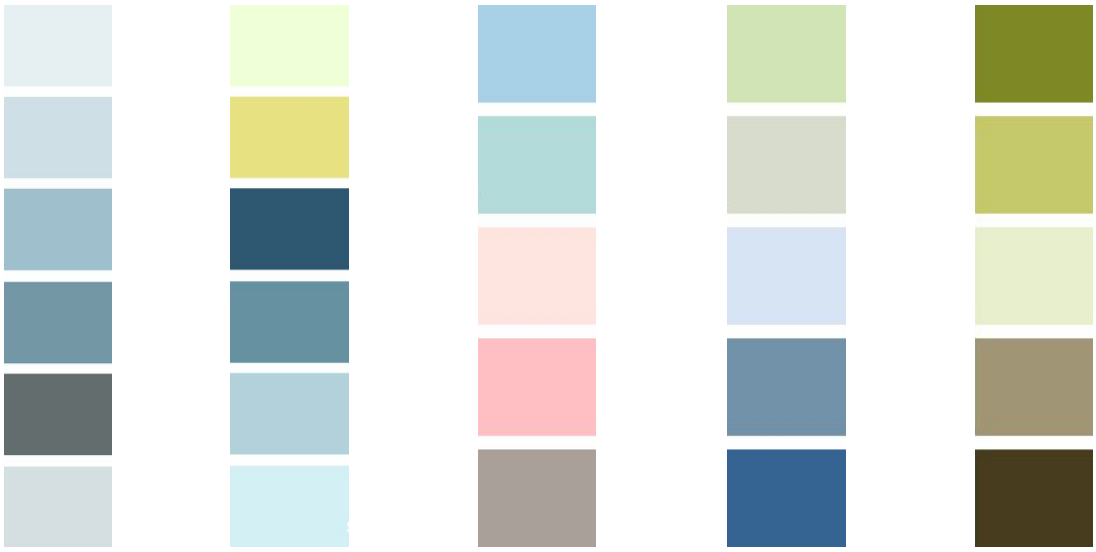
ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890 ($&.,!?)

For this thesis project, Helvetica Neue will be used for the interface design and the prototype design. This typeface is commonly used in multiple ways, and it is clear and easy to read for this thesis concept.

Sine this project will have a video prototype to help user understand this project, the video will use the same typeface as the interface design.

Design Ideation

Color studies



The above are optional color choices I studied, then I selected followed color as my main color choice. Because first they are easy to recognized on the mirror which will have reflection of reality environment, then they are all soft color that can make people feel peace and clam.

#EFFFD8	#F9F18C	#D5DFE1	#D7E4F4	#7292A9	#2E5771
R 239	R 249	R 213	R 215	R 114	R 46
G 255	G 241	G 223	G 228	G 146	G 87
B 216	B 140	B 225	B 244	B 169	B 113
C 11	C 8	C 20	C 19	C 62	C 87
M 0	M 4	M 9	M 8	M 38	M 67
Y 22	Y 54	Y 11	Y 2	Y 27	Y 47
K 0	K 0	K 0	K 0	K 0	K 6

Methodological Design

The primary objective of the project is to design an interface for an interaction device for people doing rehab after knees surgery. A demonstration of this application will be in the form of a animated video, displaying the details and capabilities. This will require learning about database management, information graphics, user interaction, user experience, motion graphics, interactivity and augmented reality, and related interaction/interface design.

Target audience

A interface for interaction mirror that encourage patients to do rehab will be build. With patients who did knees surgery as target audience, adult patients age range of 25 to 45, they will have active rehab exercises, and get better recover from injury.

Overall Project

This interface will have four modules determined by filling out the patient's information: Exercises, Mode choose, Personal status update, Setting.

Hardware/Software

The project will be built using:

Adobe Illustrator

Adobe Photoshop

Adobe InDesign

Adobe Experience Design

Adobe Premiere Pro

Adobe After Effects

Adobe Audition

Methodological Design

Deliverables

Process:

- Research related documents
- Collecting and documenting literature
- Speaking with patients and experts
- Market survey, evaluating and assessing current needs
- Prototyping interactive experiences for exercises after CPM
- Usability testing
- Imagine RIT
- Final production and presentation

Scope of Project:

- Motion graphics:

  Video prototype: 1 video, approximately 2:00 to 2:30 minutes.

  The video will have a user interactive with the mirror to help people get better understanding of how to interactive with this mirror.

- Interaction:

  Prototype: Using Adobe Experience Design to design a high quality prototype

  Interface design for interactive mirror. Including exercises instruction, muscle rebuild study, and personal information.

- Augmented Reality:

  Using illustration/infographics used to help patients get movement in right position.

  Have character in the mirror in the same position with real patients' projection.

Details of Project:

- Motion graphics dimensions:

  1920p / 1080p

  QuickTime format

  Duration: approximately 2:00 to 2:30 minutes.

Methodological Design

Deliverables

- Interactive Details:

  Software: Adobe Illustrator, Photoshop, Animate CC, Experience Design.

  Narrative component: Rehab exercises section (with AR motion graphics) with audio to interact with patients.

Methodological Design

DESIGN	TECHNOLOGY	SUBJECT MATTER
UI/UX design	Adobe Illustrator Adobe Photoshop Adobe After Effects Adobe Experience Design	Icons for interactive mirror interface
Interaction design	Adobe Illustrator Adobe Photoshop	Interactive part: Movement check and comparison for better rehab
Motion graphics	Adobe Illustrator Adobe Photoshop Adobe After Effects Adobe Audition	Short animations: Infographics Narratives

Implementation Strategies

Through comprehensive planning, this project would achieve most useful and beneficial investigation method provides a useful and comprehensive interactive experience that knee surgery patients will use and enjoy.

I will build my thesis project through visual communication design. I have a passion for interaction design and motion. During my graduate study I learn about various aspects and principles of interaction, user interface and user experience design. I learned how to design and edit videos in Adobe After Effect and other Adobe software from the 3D Modeling and Motion, Digital Design in Motion and Digital Media Integration class. And I learned interaction design skills from Web and UI Design, Typography, Interaction Design, UX Design Strategies and Experiential Graphic Design class. I would like to take this knowledge to the next professional level.

I will be working over the course of the fall of 2016 and spring of 2017 to implement all of the aspects of this project.

Using my research and potential customer interview I did on-line questionnaire survey. This was done in www.typeform.com. At the same time I will collect visual data of interface design. The interface will be designed based on the research I did and interview with patients and doctors. It will be done in Adobe Photoshop, Illustrator, Animate CC and InDesign, all of which I have a high degree of comfort using at this time. The video prototype will be crested using Adobe After Effects and Animate CC which I am still leaning but have enough experience with video editing to adequately complete any tasks. The videos will be hosted on my YouTube account and Vimeo account.

Lessons and examples will be reviewed by my committee members with additional input from other resources. The outline and syllabus will also be reviewed for completeness and compliance with RIT guidelines.

Evaluation Plan

- Publishing this thesis project on-line, using comments, likes and dislikes, and social media sharing provides an valuable feedback.

- First round will be paper prototype in order to validate the process and collect suggestions to improve user experience.

- Second round will test the high fidelity prototype. Both rounds will be qualitative with a predetermined target number of participants of up to 5 patients from diverse backgrounds.
  The location for testing shall be different depends on patients condition and willing.

- In addition to the comments and feedback of peers who will provide validation or dissension, there will be opportunities during Image RIT to get educated and non-educated feedback on articles and lessons.

Dissemination

This thesis project will have interface design and video prototype, and it will be seen by many individuals. Users will give feedback through various ways.

On campus dissemination:

Imagine RIT - May 2017

Thesis Show - May 2017

Off campus dissemination:

Adobe Design Achievement Awards

RedDot Design Awards

iF Design Award

SIGCHI Conferences

Pragmatic Considerations

Budget:

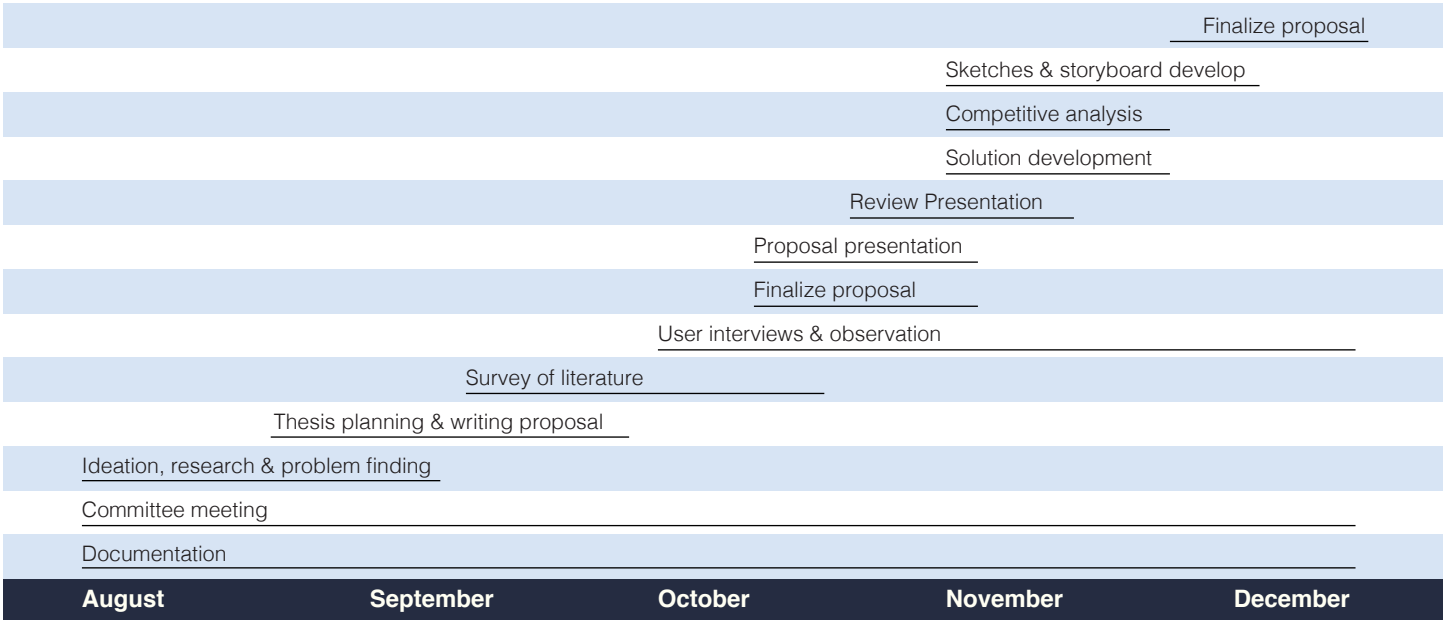
Adobe Creative Cloud: $30 per month for students.

Considerations:

This project require the well planned timeline. To get feedback of real worth, we planned to have different platform to collect information, which may cost apply fee. And have cost for software. Since it's a prototype for real interactive experience, there will be no cost for further developing.

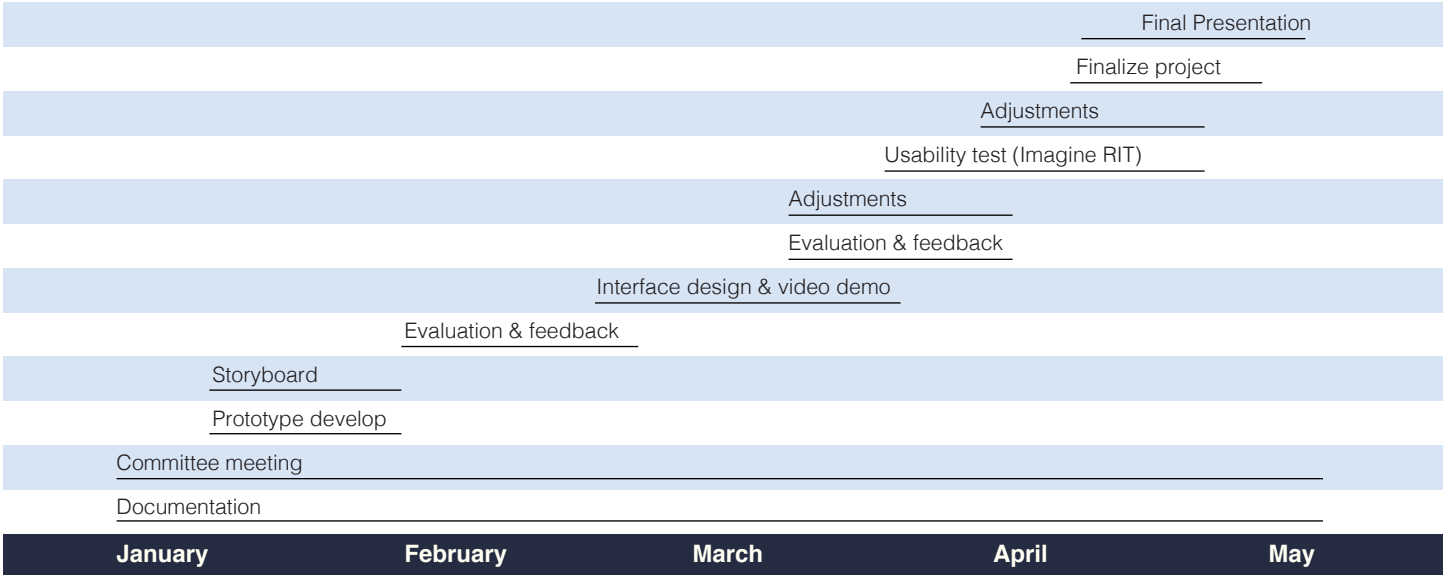
Timeline

Fall 2016



Timeline

Spring 2017



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